

APPENDIX A

***SUMMARY OF THE
ENVIRONMENTAL ASSESSMENT FOR
DEPARTMENT OF ENERGY REENTRY VEHICLES,
FLIGHT TEST PROGRAM,
US ARMY KWAJALEIN ATOLL,
REPUBLIC OF THE MARSHALL ISLANDS***

**Summary of the
Environmental Assessment for
Department of Energy Reentry Vehicles, Flight Test Program,
US Army Kwajalein Atoll, Republic of the Marshall Islands**

The following discussion provides an unclassified summary of the *Environmental Assessment for Department of Energy (DOE) Reentry Vehicles, Flight Test Program, US Army Kwajalein Atoll, Republic of the Marshall Islands*, dated August 4, 1992. The classified environmental assessment (EA) was prepared by Lawrence Livermore National Laboratory for the US Air Force Strategic Air Command, Offutt Air Force Base (AFB), Nebraska. The reentry vehicles (RVs) described in the 1992 EA are similar to the RV designs currently flown as part of the ongoing joint Department of Defense/DOE flight test program.

Department of Defense (DoD) RVs and DOE Joint Test Assembly (JTA) RVs are routinely flown as part of the US Air Force (USAF) developmental and operational Intercontinental Ballistic Missile (ICBM) flight test programs conducted at the Western Test Range (WTR). Peacekeeper and Minuteman III ICBMs launched from Vandenberg AFB, California, are routinely targeted for the US Army Kwajalein Atoll (USAKA) test range (now called Reagan Test Site), in the Republic of the Marshall Islands.

The ICBM flight test program includes several different designs of RVs containing varying quantities of depleted uranium (DU), beryllium (Be), and high explosives. A specific RV design may contain any combination of the above materials, or none. Fissile materials are not included in any flight test RV designs. Reentry vehicles containing high explosives may be detonated at some altitude (airburst) or upon impact at the surface. Following detonation, RV fragments would impact the surface at high velocity. Reentry vehicles without high explosives would impact the surface at high velocity intact and then fragment upon surface impact. Flight tests are planned for deep ocean targets, lagoon targets, and in the vicinity of Illeginni Island within the Mid-Atoll Corridor Impact Area at USAKA. Targeting in the broad ocean area north, east, and west of the Kwajalein Atoll is also planned. All target sites are routinely used in ongoing ICBM flight test programs. High explosive detonation and/or kinetic energy dissipation occurring at impact may distribute low levels of hazardous materials in the ocean, lagoon, or on land (Illeginni) near the impact point and downwind.

In 1992, the USAF prepared an environmental assessment of potential environmental consequences of the kinds of tests included in the ICBM flight test program. Results from the earlier JTA-301 flight test, the first JTA test with materials and quantities identical to those described in the 1992 EA, were used to verify the accuracy of this assessment, and in fact showed that actual levels of hazardous materials were less than those predicted.

The 1992 EA analyzed the potential effects of a water or land impact, or an airburst, of RVs containing DU and Be. An atmospheric dispersion model developed in 1990 for this application, and verified by an ongoing environmental monitoring program, was used. This model was extremely conservative in that it maximized the quantities of the source materials and incorporated a land impact as the worst-case conditions for dispersion.

The testing described in the EA was expected to result in limited, short-term impacts to the natural environment within the immediate area of the RV impact. In addition, if a land impact were to occur, most adverse effects would be mitigated by recovering RV debris and refilling impact craters. If all of the DU and Be in the RVs were to land in the atoll's lagoon or in the open ocean, there would be no impact to the marine environment. The materials are very insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background. The materials would eventually be distributed in the sediment and be of no consequence to marine species. The same is true for the DU and Be that would be deposited in the ocean or lagoon as a result of an airburst.

The major potential health and environmental concerns discussed in the EA were associated with impact on land and the subsequent effects on workers whose occupations require visits to the island, and the long-term management and restoration of the island. The concentration of Be and DU in air will be elevated only for a brief period of time following the RV impact. Measurements made after the JTA-301 test showed the concentrations of Be and DU in the air to be well below air quality standards for brief exposure to these materials. The long-term concentrations in air from resuspension will be more than a factor of 10,000 lower than the 30-day emission standard for Be and the 1-year standard for uranium (U), a measurement for DU.

The modeled interpretation of the tests and the results from the JTA-301 test and subsequent tests provide enough information to conclude that there will be no potential health effects in the immediate vicinity of the tests and that no air quality criteria will be exceeded anywhere for surface impacts or airburst tests. To make these conclusions, we assume the exclusion of personnel within 2,000 meters (m) downwind of the test area for 15 minutes following each test. Near the impact crater, in the case of land impact, precautions would be taken to recover metal fragments, to protect workers from respiratory exposure, and to secure the area from inadvertent traffic until recovery is complete.

Potential ecological effects on land at Illeginni can be assessed on the basis of deposition and concentration patterns in air observed downwind after testing JTA-301, and several subsequent tests conducted as part of the ongoing flight test program. Debris and ejecta occur close to the point of impact, mostly within a 100 m radius. Deposition of small particles contribute to elevated levels in soil in the immediate vicinity of the impact and extending downwind. The concentration of soluble Be in soil will be orders of magnitude below the observed phytotoxicity concentration of 2 micrograms per gram ($\mu\text{g/g}$) soluble Be. In view of the fact that the concentration in the area of highest deposition after JTA-301 was only 0.5 $\mu\text{g/g}$ and that Be is extremely insoluble, there will be no impact to plants. The potential effects on animals from breathing respirable dust, or consuming particles deposited on vegetation, would be insignificant. Beyond 50 m from the crater, under probable meteorological conditions, there will be deposition on the water surface. The process of mixing of Be and DU by tide and surf would rapidly dilute the small amounts deposited, and concentrations would be low and non-toxic to fish, considering the low solubility of the Be and DU. Eventually, the Be and DU would be deposited as sediment, where it would slowly weather just as it does in the soil.

For an ocean impact or deposition on water, no cleanup would be required. However, in the case of a lagoon impact, debris would be recovered.

For airburst tests, most of the deposition would be over water and would be of no significant concern, as discussed above. Any deposition of respirable-size material over land would be less than the land impact situation; the deposition on land from an airburst would have to meet the same criteria as listed for land impact.

As part of RV testing, the following mitigation measures would be applied:

- 1) Exclude personnel during the tests.
- 2) Protect personnel from exposure during post-test operations near the impact crater.
- 3) Maintain exclusionary control near a land impact crater and downwind of the crater prior to recovery action.
- 4) Recover parts and debris as much as reasonably prudent near the impact crater, to include collecting visible debris from the RV that is in the crater and on the island. Excavate the impact crater to recover small particle RV debris after scoring and mapping operations are complete. Use standard USAKA procedures involving screening and washing of material removed from the crater.
- 5) Set up an array of air samplers and deposition collectors during and after the actual tests to estimate downwind concentrations and deposition patterns for environmental management purposes.
- 6) Minimize helicopter and vehicular traffic in the vicinity of a land impact crater until the soil deposition is stabilized by wetting, and the helipad has been washed or swept down.
- 7) Conduct sampling of the air and soil to ensure that the concentration in air of Be and of DU does not exceed established standards.
- 8) Maintain necessary surveillance of the cumulative effect from repetitive tests to ensure that the criteria listed in item (7) are maintained.
- 9) Maintain records of Be and U concentration in air and soil to document the tests for the landowners and regulatory agencies.
- 10) Avoid unnecessary disturbance of seabird nests.
- 11) Refill any crater that is large enough to warrant the action in a manner that is least damaging to the environment, with precautions taken to avoid exposure of personnel to any hazardous levels of Be and DU.

Results from the JTA-301 test showed deposition concentrations of Be and DU in the soil to be slightly greater than natural background concentrations. The concentration of Be and DU in air resulting from the deposition were orders of magnitude below US Federal guidelines. Consequently, for further tests, additional mitigation measures beyond what is identified above are not anticipated.

However, the concentrations of Be and DU in air will be measured after each test to ensure that the cumulative deposition on Illeginni Island does not lead to concentrations that exceed US Federal guidelines. Removal of the top 0 to 2 inches (0 to 5 cm) of soil would be required if concentrations exceeded established standards.

APPENDIX B

IMPACTS OF THE PROPOSED MINUTEMAN III REENTRY VEHICLE FLIGHT TESTS ON MARINE MAMMALS AND SEA TURTLES AT KWAJALEIN ATOLL, THE REPUBLIC OF THE MARSHALL ISLANDS

MINUTEMAN III MODIFICATION ENVIRONMENTAL ASSESSMENT

IMPACTS OF THE PROPOSED MINUTEMAN III REENTRY VEHICLE FLIGHT TESTS ON MARINE MAMMALS AND SEA TURTLES AT KWAJALEIN ATOLL, THE REPUBLIC OF THE MARSHALL ISLANDS

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TABLE OF CONTENTS

| Section | Description | Page No. |
|---------|--|----------|
| | Abstract | 1 |
| 1. | Introduction | 2 |
| 1.1. | Compact of Free Association between the Government of the United States of America and the Government of the Republic of the Marshall Islands | 3 |
| 1.2. | Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of Marshall Islands | 3 |
| 2. | Establishment of Temporary Threshold Shift (TTS) and Physical Injury Criteria for Marine Mammals and Sea Turtles | 4 |
| 2.1. | Previously Established TTS, Physical Injury and Mortality Criteria | 5 |
| 2.2. | Establishment of TTS and Physical Injury Criteria for the Proposed Minuteman III Reentry Vehicle (RV) Flight Tests on Marine Mammals and Sea Turtles | 5 |
| 3. | Definition of the Marine Mammal and Sea Turtle Habitation Well and the RV Acoustic Impact Well, and Computation of Their Volumes | 6 |
| 3.1. | Definition of the Habitation Well: Assumptions and Constraints Utilized | 6 |
| 3.2. | Computation of the Volume of the Habitation Well, V_{HW} | 7 |
| 3.3. | Definition of the RV Acoustic Impact Well: Assumptions and Constraints Utilized | 7 |
| 3.4. | Computation of the Volume of the Acoustic Impact Well, V_{AIW} | 8 |
| 4. | Computation of the Probabilities of Impacts of the Proposed Minuteman III RV Flight Tests on Marine Mammals and Sea Turtles | 9 |
| 4.1. | Definition of the Overall Probability of Acoustic Impact, P_{OPAI} | 9 |
| 4.2. | Computation of the Overall Probability of Acoustic Impact, P_{OPAI} | 10 |
| 4.3 | Definition and Computation of Total Energy Flux, E_T | 11 |
| 4.4. | Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Survey Data Provided by the National Marine Fisheries Service Regional Office, Honolulu, Hawaii | 12 |
| 4.5 | Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Opportunistic Sighting Data Provided by the Department of Energy/Lawrence Livermore National Laboratory | 14 |

| Section | Description | Page No. |
|----------------|---|-----------------|
| 4.6. | Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Survey Data Collected by the Marine Mammal Research Program, Acoustic Thermometry of Ocean Climate, for the Pacific Missile Range Facility EA, and Provided by the US Army Space and Missile Defense Command | 14 |
| 4.7. | Estimation of TTS and Physical Injury Impacts on Sea Turtles from the Survey Data Provided by the Fish and Wildlife Service Regional Office, Honolulu, Hawaii | 15 |
| 5. | Conclusion | 17 |
| | Acknowledgements | 18 |
| | References | 19 |
| | Symbols | 21 |
| | Abbreviations | 22 |

IMPACTS OF THE PROPOSED MINUTEMAN III REENTRY VEHICLE FLIGHT TESTS ON MARINE MAMMALS AND SEA TURTLES AT KWAJALEIN ATOLL, THE REPUBLIC OF THE MARSHALL ISLANDS

ABSTRACT

The proposed reentry vehicle (RV) flight test involves launching of a Minuteman III missile that carries one or more RVs, from Vandenberg Air Force Base (AFB), California, and targeting it for either land or deep ocean impact in the vicinity of Illeginni or Kwajalein Missile Impact Scoring System (KMISS) Island, the Republic of the Marshall Islands (RMI). The RV is expected to enter the ocean at a predetermined angle to the ocean surface⁴ in the vicinity of Illeginni or KMISS Island, and disintegrate and dissipate most of its kinetic energy at a depth of about 6.9 m from the ocean surface, simulating a single underwater impulse. On the basis of recent investigations^{11,16,17} involving the exposure of marine mammals, especially white whale and dolphin, to single underwater impulses, sound pressure levels (SPLs) of 224 and 240 dB re 1 μPa (equivalent to total energy fluxes of 209 and 225 dB re 1 $\mu\text{Pa}^2\text{-s}$) have been established as the criteria for the onset of temporary threshold shift (TTS) in their hearing abilities, and for physical injury to their auditory [permanent threshold shift (PTS)], respiratory (lung hemorrhage), and gastrointestinal systems, ultimately resulting in their death. A probabilistic impact model is developed for the purpose of estimating the TTS and physical injury impacts of the proposed Minuteman III RV (MMIIRV) flight tests on marine mammals and sea turtles (MMST). The concepts of acoustic impact well (AIW) and habitation well (HW) for MMST are defined, and utilized in the development of the probabilistic impact model.

The source strength of an MMIIRV is $3.06\text{E}+06 \text{ Pa-m}$, and the SPL generated by the disintegration of the RV is expected to attenuate to 240 dB re 1 μPa at an acoustic impact radius (AIR) of 3.1 m from the point of RV disintegration. A careful consideration and analysis of the RV impact and disintegration configuration⁴ at a recent peer review meeting³⁴ lead to the following conclusions: (a) The MMST may be seriously and permanently injured or killed from nonacoustic impacts if at the time of RV disintegration, they are within a distance of 15 m from the point of RV disintegration, and (b) the generalized equation (equation 4) utilized to compute the radial distances for acoustic impacts corresponding to the minimum SPLs that may cause TTS and physical injury impacts, may not fully account for the near field nonlinear, nonacoustic effects created by the turbulent heat, mass, and momentum fluxes that accompany the RV impact on the ocean surface, and its disintegration at a depth of about 6.9 m. At a radial distance of 15 m from the point of RV disintegration, the SPL is expected to attenuate to 226 dB re 1 μPa (30 psi) which is only 2 dB higher than the established TTS limit. Nevertheless, in order to err on the side of caution, a radial distance of 15 m rather than the AIR of 3.1m computed for an SPL of 240 dB re 1 μPa using equation 4, has been utilized to compute the volume of the AIW, and the overall probability of physical injury to MMST from acoustic impacts, $P_{\text{OPAI@240}}$.

Marine mammals occur in groups, and group is the fundamental unit of choice for the quantification of marine mammal sightings during aerial and shipboard surveys¹⁰. Hence, the group density of marine mammals rather than their individual species density is utilized in this impact analysis. Sea turtles are solitary animals, and hence, a group size of unity is assumed in

the impact calculations¹⁰. On the basis of (a) the assumptions made on MMST group sizes, (b) the probabilistic impact model developed, (c) the acoustic impact criteria established, and (d) the rationale developed for the use of a minimum impact radial distance of 15 m, the overall probabilities of the TTS ($P_{\text{OPAI@224}}$) and physical injury ($P_{\text{OPAI@240}}$) impacts of the proposed MMIIIRV flight tests on MMST have been estimated to be 4.98E-08 and 2.41E-08 respectively. The limited amount of survey data available for sea turtles^{6,10,30} in the marine biological literature indicates that the impacts of the proposed MMIIIRV flight tests on sea turtles would be similar to their impacts on marine mammals. From the aerial survey data on MMST²⁸ collected by the Regional Offices of the United States Fish and Wildlife Services (USFWS), and the National Marine Fisheries Service (NMFS), Honolulu, Hawaii over the test area in the vicinity of Illeginni Island, (i) the number of sea turtles or the number of groups of marine mammals that may experience TTS, N_{TTS} as a result of the proposed MMIIIRV flight tests has been estimated to be 4.98E-07, and (ii) the number of sea turtles or the number of groups of marine mammals that may suffer physical injury (incidental take), N_{IT} as a result of the proposed MMIIIRV flight tests has been estimated to be 2.41E-07. The N_{TTS} and N_{IT} estimates clearly indicate that the impacts of the proposed MMIIIRV flight tests on MMST at Kwajalein Atoll is quite insignificant. In addition, the nearly identical N_{TTS} and N_{IT} estimates obtained from the survey data^{13,22-24} collected by the Marine Mammal Research Program (MMRP) of the Acoustic Thermometry of Ocean Climate (ATOC), for the Pacific Missile Range Facility (PMRF) strongly support and validate the assumptions made and the constraints applied in the definition of the AIW and HW, and in the development of the probabilistic impact model, and the analytical approach utilized in the computation of the probabilities for the onset of TTS and physical injury impacts on MMST.

1. INTRODUCTION

National Environmental Policy Act (NEPA)²⁷ of 1969, Section 102 (A) directs the interpretation and administration of the policies, regulations, and public laws of the United States (US) in accordance with the NEPA policies, and requires all agencies of the Federal Government to utilize a systematic, interdisciplinary approach in order to insure the integrated use of natural and social sciences and the environmental design arts in planning and decision making which may have an impact on man's environment. The purpose of NEPA is to ensure that environmental factors are given the same consideration as any other factors in decision-making by the federal agencies. Since the enactment of NEPA, the environmental law has evolved into a comprehensive system of laws and regulations encompassing Treaties including Compacts, Executive Orders, statutes, regulations, guidelines, and case laws.

Executive Order (EO) 12114⁹ provides the exclusive and complete requirement for the consideration of major federal actions that may have a significant impact on the environment outside the territorial waters (twenty-four nautical miles from the nearest shoreline) of the United States, and requires the proponent federal agencies to analyze and document the impact of their proposed actions on the environment outside this territorial limit, consistent with the requirements of national security and foreign policy. The EO furthers the purpose of the NEPA, the Endangered Species Act⁷, the Marine Protection, Research and Sanctuaries Act¹⁹, and the Deepwater Port Act⁵, and requires the same types of analysis and documentation as required by NEPA. NEPA applies to major federal actions within the territorial waters of the United States whereas EO 12114 applies to major federal actions performed outside this territorial limit. The

Code of Federal Regulations, 32 CFR 187² provides the policy and procedures to enable the Department of Defense (DOD) officials to be informed of, and to take into consideration the potential impact of the proposed DOD actions on the environment outside the territorial waters of the United States when authorizing or approving such actions.

1.1. Compact of Free Association Between the Government of the United States of America and the Government of the Republic of the Marshall Islands

Section 161(a)(1) of the Compact of Free Association between the Government of the United States of America and the Government of the Marshall Islands³ requires the Government of the United States to apply the Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of Marshall Islands (8th Edition)⁸ to its activities at USAKA. Section 161(a)(2) of the Compact obligates the Government of the United States to apply NEPA to its activities under the Compact, and its related agreements as if the Marshall Islands were part of the United States of America.

1.2. Environmental Standards and Procedures for United States Army Kwajalein Atoll Activities in the Republic of Marshall Islands

Section 3-4.5 of the USAKA Environmental Standards (UES)⁸ which governs the protection of threatened and endangered species at USAKA, requires the establishment of a formal consultation and coordination process with the appropriate agencies that constitute the USAKA project team, to ensure that actions taken at USAKA will not jeopardize the continued existence of the threatened and endangered species or result in the destruction or adverse modification of their habitats.

On October 23, 2003, pursuant to the requirements of the UES, the Intercontinental Ballistic Missiles (ICBM) System Program Office (SPO), the Air Force Space Command (AFSPC), and the Space and Missile Systems Center (SMC) held an informal Consultation and Coordination Meeting³² in Honolulu, Hawaii with USFWS, NMFS, USAKA Environmental Management Office, and the United States Army Space and Missile Defense Command (USASMDC). At the meeting, USFWS, NMFS and USAKA representatives (a) reported sightings of sperm whales and sea turtles in the vicinity of Illeginni Island at Kwajalein Atoll, (b) stated their concerns regarding the potential impact of the proposed MMIIIRV flight tests on the MMST, and their habitats, and (c) recommended that the Minuteman III Modification Environmental Assessment (EA) list and describe the appropriate and necessary measures to mitigate the impact of the proposed MMIIIRV flight tests on the MMST and their habitats.

On January 7, 2004, at the Consultation and Coordination Meeting³³ in Honolulu, Hawaii, the ICBM SPO and SMC had agreed to determine the potential impact of the proposed MMIIIRV flight tests on the MMST, and their habitats caused by (a) the sonic boom associated with the RV flight over Kwajalein Atoll, and (b) the shock waves generated by the splashdown on the ocean surface, and disintegration underwater of RV and/or RV components. SMC had accepted the responsibility for the sonic boom analysis, and ICBM SPO had accepted the responsibility for the estimation of the shock wave impact on MMST.

2. ESTABLISHMENT OF TEMPORARY THRESHOLD SHIFT AND PHYSICAL INJURY CRITERIA FOR MARINE MAMMALS AND SEA TURTLES

The impacts of the proposed MMIII RV flight tests on MMST, caused by sonic boom and shock waves may be acoustic and/or nonacoustic. Acoustic impacts include temporary behavioral changes characterized by TTS in their hearing abilities, disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding or sheltering (Level B Harassment). Nonacoustic impacts include direct physical injury to their auditory [permanent threshold shift (PTS)], respiratory (lung hemorrhage), and gastrointestinal systems, ultimately resulting in their death, and death or failure of sea turtle eggs or marine mammal embryos to reach their next developmental stage. Nonacoustic impacts on MMST may be caused by collisions with ships, falling objects, and shrapnel from exploding charges, and contacts with, or ingestion of debris and hazardous materials. Fast-moving objects such as meteorites and missiles that enter the ocean, may not only hit the MMST inflicting direct physical injury (nonacoustic impact) to the animals, but they may also generate shock waves that may degenerate into acoustic waves¹ capable of causing acoustic impacts to the MMST. Hence, injury to MMST from shock waves may be acoustic and/or nonacoustic.

Acoustic impacts may be lethal or sublethal. Lethal impacts may cause immediate death or serious physical injury to the impacted animals whereas sublethal impacts may cause a decrease in their hearing sensitivity. Decrease in hearing sensitivity shifts the hearing threshold of the impacted animals to a higher SPL. The shift to a higher threshold may be temporary (recoverable, TTS) or permanent (PTS). Sublethal impacts may cause behavioral reactions in MMST including panic, habitat abandonment, refusal to nurse their infants, and impairment in their ability to forage or detect and escape predators, and hence, may ultimately result in their death.

The inner ears of marine mammals are structurally modified from those of their terrestrial counterparts in such a way as to accommodate rapid pressure transients, and render them acoustically more sensitive^{10,16,17}. In addition, marine mammals are naturally protected from self-generated sounds, structurally (anatomically) by the impedance mismatches of the intervening tissues, and functionally (physiologically) by the eardrum and ossicular tensors¹⁷. Impedance is a concept utilized in electrical, electronic and communication engineering²⁹ to represent the dynamic resistivity of a system or its components. Impedance mismatch between components in a signal processing pathway will attenuate the signal strength, which is generally an undesirable consequence of equipment obsolescence. Impedance mismatch between structural members of the inner ears of marine mammals attenuates the SPL, and pressure-transduced electrical signals, and protects the marine mammals from direct physical injury to their auditory system.

The self-generated sounds of marine mammals are initiated in coordination with their protective mechanisms, and hence, they are anticipated¹⁷. On the other hand, external sounds including those generated by the proposed MMIIIRV flight tests are not anticipated, and hence, marine mammals are not adequately protected from their impacts. Very little direct data is currently available for TTS or physical injury impacts on sea turtles³⁰. Hence, it is necessary to establish the criteria for TTS and physical injury impacts of the proposed MMIIIRV flight tests

to MMST, and to protect them by ensuring that the SPL generated by the underwater disintegration of the RV, does not exceed these established limits at target locations.

2.1. Previously Established TTS, Physical Injury and Mortality Criteria

Table 1 summarizes the general TTS, physical injury and mortality impact criteria established for the WINSTON S. CHURCHILL (DDG 81) Shock Trial in its Final Environmental Impact Statement (EIS) on the basis of blast test experiments involving pulse trains *vice* single pulses¹⁰.

Table 1. General TTS, Physical Injury and Mortality Criteria Established For WINSTON S. CHURCHILL (DDG 81) Shock Trial

| Impact Category | Threshold, dB | Threshold, psi | Threshold, Pa-s |
|-----------------|---------------|----------------|-----------------|
| TTS | <u>182</u> | 0.18 | 75 |
| Physical Injury | 189.39 | 0.43 | <u>175</u> |
| Mortality | 195.75 | 0.89 | <u>364</u> |

The Sound pressure level in dB is referenced to 1 μ Pa. The established threshold criteria are underlined, and their equivalents in the other most commonly used units are listed for convenience.

Darlene Ketten^{16,17} of Harvard Medical School, and Woods Hole Oceanographic Institution has recommended the following criteria for TTS and lethal injury impacts caused by single impulses:

- (a) TTS for single pulses: 5 – 15 psi peak overpressure (210.75 – 220.29 dB re 1 μ Pa).
- (b) Lethal or compulsory injury zone for fast rise time (short duration pulses, simulating impulses), complex waveforms (not pure sinusoids such as sine and cosine waves): 240 dB re 1 μ Pa (145 psi).

2.2. Establishment of TTS and Physical Injury Criteria for the Proposed Minuteman III Reentry Vehicle Flight Tests on Marine Mammals and Sea Turtles

Most recent investigations lead by Jim Finneran¹¹ at Space and Naval Warfare Systems Center, San Diego, utilizing single underwater impulses have suggested the following TTS criteria for white whale and dolphin.

- (a) 23 psi peak pressure (224 dB re 1 μ Pa) for white whale.
- (b) 30 psi peak pressure (226 dB re 1 μ Pa) for dolphin.

The underwater disintegration of the Minuteman III flight test RV simulates a single impulse rather than a pulse train. Hence, the ICBM System Program Office has established the

following criteria (Table 2) for the TTS and physical injury impacts on MMST for this special case.

Table 2. TTS and Physical Injury Criteria Established by the ICBM System Program Office for the Impacts of the Proposed Minuteman III RV Flight Tests

| Impact Category | Threshold, dB | Threshold, psi | Threshold, Pa-s | Reference |
|-----------------|---------------|----------------|-----------------|-------------------------|
| TTS | <u>224</u> | 23 | 9414 | Finneran ¹¹ |
| Physical Injury | <u>240</u> | 145 | 59400 | Ketten ^{16,17} |

The Sound pressure level in dB is referenced to 1 μ Pa. The established threshold criteria are underlined, and their equivalents in the other most commonly used units are listed for convenience.

A careful consideration and analysis of the RV impact and disintegration configuration⁴ at a recent peer review meeting³⁴ has lead to the determination that the MMST may be seriously and permanently injured or killed from nonacoustic impacts if at the time of RV disintegration, they are within a distance of 15 m from the point of RV disintegration. However, no specific criterion is established for the mortality impact of the proposed MMIIIRV flight tests on MMST.

3. DEFINITION OF THE MARINE MAMMAL AND SEA TURTLE HABITATION WELL AND RV ACOUSTIC IMPACT WELL, AND COMPUTATION OF THEIR VOLUMES

3.1. Definition of the Habitation Well: Assumptions and Constraints Utilized

The MMST have been assumed to live in a cylindrical Habitation Well of 24,140 m (15 miles) radius and 250 m depth on the basis of the following considerations:

- (a) During ICBM RV flight tests, the essential personnel are warned to stay away at least 10 miles, and nonessential personnel are warned to stay away an additional 5 miles from the expected point of RV impact on land or splashdown on the ocean surface,^{12,15}.
- (b) If a group of MMST is sighted during an aerial survey performed 2 hours immediately prior^{12,15} to the scheduled launch of a Minuteman III missile, at a distance of about 24,140 m from the expected point of RV disintegration underwater, and if all the groups of MMST whether they are on or underneath the ocean surface, are assumed to be located at distances of at least 24,140 m from the point of RV disintegration, it is unlikely that any of them will reach the AIW at the exact time of RV splashdown and disintegration if they drifted in a random manner with no preferred direction, and at no preferred speed. Therefore, the HW surface area is computed using a radius of 24,140 m.
- (c) The MMST are likely to spend most of their time near the surface of the ocean, down to a depth of about 250 m, due to the availability of food near the surface. Whales have been

where r_s refers to the surface radius (AE) of the AIW.

r refers to the radius (BE = BC) of the AIW, computed from the RV source strength for a given overpressure at a target location.

d refers to the depth (AB) at which the RV is expected to disintegrate, computed from AD using a reentry angle of 28 degree: 6.9 m.

3.4. Computation of the Volume of the Acoustic Impact Well, V_{AIW}

Volume of the AIW, a sphere of radius, r truncated by the ocean surface is computed using the following formula.

$$V_{AIW} = \pi \left(r^2 d - \frac{d^3}{3} + \frac{2}{3} r^3 \right) \quad (3)$$

in which V_{AIW} refers to the volume of the AIW. Equation 3 is obtained by integration of the truncated sphere.

The AIR, r is a function of the source strength of an intact MMIIIIRV, and the overpressure is measured at the target location. It is computed using the following equation²⁵.

$$r = \left(\frac{S}{P - P_{inf}} \right) \quad (4)$$

where S is the source strength of the intact RV, 3.06E+6 Pa-m,

$P - P_{inf}$ is the measured overpressure, Pa

P_{inf} is the ambient pressure, Pa.

The TTS and physical injury impact criteria established in Section 2.2 are stated in terms of the SPL measured in dB at target locations. The SPL at a target location is computed from the overpressure measured at the target location using the following equation²⁵.

$$SPL = 20 \log \left(\frac{P - P_{inf}}{P_{ref}} \right) \quad (5)$$

in which P_{ref} is the reference pressure which is 1.0E-6 Pa for water. Conversely, the expected overpressure at a target location can be computed using equation 5 for an impact criterion, and utilized for the computation of the AIR using equation 4. Since the reference pressure for water is 1 μ Pa, equation 5 can be simplified and rewritten as equation 6 by expressing the overpressure and the reference pressure in μ Pa.

$$SPL = 20 \log(P - P_{inf}) \quad (6)$$

4. COMPUTATION OF THE PROBABILITIES OF IMPACTS OF THE PROPOSED MINUTEMAN III RV FLIGHT TESTS ON MARINE MAMMALS AND SEA TURTLES

4.1. Definition of the Overall Probability of Acoustic Impact, P_{OPAI}

The following assumptions are made in defining the probability of acoustic impact of the proposed MMIIIRV flight tests on MMST^{14,21,37,38}.

- (a) If there is a sea turtle or a group of marine mammals in the HW, and if it is divided into volume segments equivalent to the volume of the AIW, each volume segment is equally accessible to the sea turtle or the group of marine mammals for habitation at any instant of time.
- (b) If the sea turtle, or the group or a member of the group of marine mammals is within the AIW at the time of RV disintegration, it will experience either a TTS or suffer physical injury, depending on its location from the point of RV disintegration.

If there is a sea turtle or a single group of marine mammals in the HW, the probability that it will be within the AIW at the time of RV disintegration, is the same as the probability of it being in any one of the equivalent volume segments. It is just the ratio of the volume of the AIW to the volume of the HW.

$$P_{\text{AIW}} = \frac{V_{\text{AIW}}}{V_{\text{HW}}} \quad (7)$$

in which P_{AIW} refers to the probability that the sea turtle, or the group or a member of the group of marine mammals is within the AIW.

If a sea turtle, or a group or a member of a group of marine mammals is already within the AIW at the time of RV disintegration, it will be impacted, and the probability of impact is one. This is a conditional probability of acoustic impact, denoted by $P_{\text{IMP/AIW}}$. The compound probability of acoustic impact of the proposed MMIIIRV flight tests on MMST is defined as the product of the two probabilities:

$$P_{\text{CPAI}} = P_{\text{AIW}} P_{\text{IMP/AIW}} = \frac{V_{\text{AIW}}}{V_{\text{HW}}} \quad (8)$$

where P_{CPAI} is the compound probability of acoustic impact,

$P_{\text{IMP/AIW}}$ is the conditional probability of acoustic impact given the fact that a sea turtle, or a group or a member of a group of marine mammals is already within the AIW.

If the Minuteman III missile carries more than one RV during a flight test, the volume of the AIW for a single RV must be multiplied by the number of RVs onboard the missile in order

to obtain the total volume of the AIW for all the RVs, assuming that the RVs are independently targeted for splashdown and impact at different locations. This will result in an overall probability of acoustic impact on MMST which is the compound probability of acoustic impact times the number of RVs flight tested onboard a single Minuteman III missile. The overall probability of acoustic impact is computed using equation 8.

$$P_{OPAI} = P_{CPAI} N_{RV} = P_{AIW} P_{IMP/AIW} N_{RV} = \frac{V_{AIW}}{V_{HW}} N_{RV} \quad (9)$$

where P_{OPAI} is the overall probability of acoustic impact,

N_{RV} is the number of RVs flight tested onboard a single Minuteman III missile.

4.2. Computation of the Overall Probability of Acoustic Impact, P_{OPAI}

The source strength of an MMIII RV is 3.06E+06 Pa-m (443.63 psi-m), and the SPL generated by the disintegration of the RV is expected to attenuate to 240 dB re 1 μ Pa at an AIR of 3.1 m from the point of RV disintegration. A careful consideration and analysis of the RV impact and disintegration configuration⁴ at a recent peer review meeting³⁴ lead to the following conclusions: (a) The MMST may be seriously and permanently injured or killed from nonacoustic impacts if at the time of RV disintegration, they are within a distance of 15 m from the point of RV disintegration, and (b) the generalized equation (equation 4) utilized to compute the radial distances for acoustic impacts corresponding to the minimum SPLs that may cause TTS and physical injury impacts, may not fully account for the near field nonlinear, nonacoustic effects created by the turbulent heat, mass, and momentum fluxes that accompany the RV impact on the ocean surface, and its disintegration at a depth of about 6.9 m. At a radial distance of 15 m from the point of RV disintegration, the SPL is expected to attenuate to 226 dB re 1 μ Pa (30 psi) which is only 2 dB higher than the established TTS limit. Nevertheless, in order to err on the side of caution, a radial distance of 15 m rather than the AIR of 3.1m computed for an SPL of 240 dB re 1 μ Pa using equation 4, has been utilized to compute the volume of the AIW, and the overall probability of physical injury to MMST from acoustic impacts, $P_{OPAI@240}$.

The overall probabilities of TTS (at 224 dB re 1 μ Pa, which is equivalent to a total energy flux, E_T of 209 dB re 1 μ Pa²-s) and physical injury impact (at 240 dB re 1 μ Pa equivalent to an E_T of 225 dB re 1 μ Pa²-s) were calculated using equation 9. Previously, physical injury impact was estimated using a 12 psi (218 dB re 1 μ Pa equivalent to an E_T of 193 dB re 1 μ Pa²-s) criterion^{16,17}. Refer to Table 3.

Table 3. Probabilities of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles for the Intact Minuteman III Flight Test RV

| Sound Pressure Level, dB re 1 μ Pa | Total Energy Flux, E_T dB re 1 μ Pa ² -s | Overpressure at Target Location, psi | Minimal AIR for Intact MMIIIRV, m | Probability of Impact, P_{OPAI} |
|--|---|--------------------------------------|-----------------------------------|-----------------------------------|
| 218 | 193 | 12 | 39 | 3.31E-07 |
| 224 | 209 | 23 | 19 | 4.98E-08 |
| 240 | 225 | 145 | 15 | 2.41E-08 |

4.3. Definition, and Computation of Total Energy Flux, E_T

Total energy flux is frequently utilized along with SPL in the marine biological literature to set acoustic impact criteria for protected marine species, and to compare acoustic impact levels among species. The total energy flux at a certain sound pressure level is defined by equation 10.

$$E_T = 10\text{LOG}\left\{\frac{(P - P_{\text{inf}})^2 t_+}{P_{\text{ref}}^2 t_{\text{ref}}}\right\} = 20\text{LOG}(P - P_{\text{inf}}) + 10\text{LOG}(t_+) \quad (10)$$

Where E_T is the total energy flux, dB re 1 μ Pa²-s,

P refers to pressure, μ Pa,

$P - P_{\text{inf}}$ is the measured overpressure, μ Pa,

P_{ref} is 1 μ Pa,

t_{ref} is 1 s,

t_+ refers to the duration of the positive phase of a pulse, s.

The first term on the right hand side of equation 10 is the SPL defined by equation 6, and hence, equation 10 can be written compactly as equation 11.

$$E_T = \text{SPL} + 10\text{LOG}(t_+) \quad (11)$$

The average length of the positive phase of a shock wave is 0.03 s for the hypersonic impact of objects on the ocean surface²⁵. For $t_+ = 0.03$ s, the contribution of the $10\text{LOG}(t_+)$ term in equation 11 to the total energy flux is -15.23 dB. Hence, for the hypersonic impact of an MMIIIRV on the ocean surface, the total energy flux corresponding to an SPL is obtained by subtracting 15 dB from the SPL.

4.4. Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Survey Data Provided by the National Marine Fisheries Service Regional Office, Honolulu, Hawaii

The number of groups of marine mammals impacted is computed by multiplying the total volume ($V_{AIW} N_{RV}$) of the AIW by marine mammal group density. Also, it can be readily obtained by multiplying the overall probability of acoustic impact (P_{OPAI}) by the estimated number of groups of marine mammals present in the HW as shown in equation 12.

$$V_{AIW} N_{RV} D_{MM} = V_{AIW} N_{RV} \left(\frac{N_{HW}}{V_{HW}} \right) = N_{HW} \left(\frac{V_{AIW}}{V_{HW}} N_{RV} \right) = N_{HW} P_{OPAI} \quad (12)$$

where D_{MM} is the group density of MMST,
 N_{HW} is the number of groups of MMST in the HW.

Aerial or shipboard surveys of MMST are usually performed a number of times over a period of several months to a few years^{6,10,13,20,22-24,31}. It is assumed that any one group of MMST is detected only once in any one survey, in estimating the number of groups of MMST that will likely experience TTS, N_{TTS} , and the number of groups of MMST that will likely suffer physical injury (incidental take), N_{IT} , as a result of the proposed MMIIIRV flight tests. The total number of groups in each category of MMST detected in all the surveys are divided by the number of surveys in order to ensure that the same group of MMST are not counted more than once. It is this average number of groups (ANG) of MMST that is used to compute the number of groups of MMST acoustically impacted by the proposed MMIIIRV flight tests.

Aerial or shipboard surveys of MMST will detect only those animals that are on the surface of the ocean at the time of the surveys. At any instant of time, only a small fraction of MMST will be on the surface, and hence, only that fraction of MMST will be available for visual detection. There is a wide variation ranging from 0.1 to 0.5, in the reported fractions of MMST available for visual detection^{6,10,20,31}. The fraction of MMST available at any instant of time for visual detection is equivalent to the fraction of time a group of MMST is available for visual detection which is the probability of visual detection, P_{VDET} .

$$P_{VDET} = \frac{t_s}{t_T} \quad (13)$$

where t_s is the average length of time the group of MMST remains on the surface of the ocean,
 t_T is the average total length of time of an MMST submergence/nonsubmergence cycle.

The number of groups of MMST visually detected must be corrected for the availability bias (the submerged fraction of the MMST) in order to estimate the total number of groups that will likely be present in a body (volume) of water. This is accomplished by dividing the number of groups of MMST visually detected by P_{VDET} , which is also known as the submergence

correction factor. The TTS and physical injury impacts of the proposed MMIIIRV flight tests on MMST are computed using a P_{VDET} of 0.1 which is the most conservative submergence correction factor reported in the marine biological literature for the estimation of impacts on sea turtles^{6,10,20,31}.

Aerial surveys for MMST are performed by establishing transects (tracts) of certain width, spaced appropriately, and then flying a survey team over a randomly selected set of transects^{6,10,20,31}. The survey will cover only a fraction of the test area. Hence, the data must be corrected for survey effectiveness. A Survey Effectiveness Factor (SEF) for the PMRF survey is not available. On the assumption that the PMRF SEF must be comparable to the SEFs utilized in other impact estimates^{6,10,20,31}, an SEF of 0.446 that was used in the groundbreaking EIS for the WINSTON S. CHURCHILL (DDG 81) Shock Trial¹⁰, is used to correct the PMRF survey data.

The NMFS reported the sighting of a group of sperm whales²⁸ over the Kwajalein Atoll test site, assumed to be a circular area of 15 mile radius, in the vicinity of Illeginni Island, during each of its two surveys performed during the years 2000 and 2002. It is very unlikely that an aerial survey of this small test site with low marine mammal densities would have failed to detect all the marine mammals present on the surface. Hence, application of an SEF correction, in addition to the most conservative submergence correction ($P_{\text{VDET}} = 0.1$), to this survey data may overestimate the risk of impact, distort the true picture, and mislead the interested public.

The number of groups of MMST that will likely experience TTS as a result of the proposed MMIIIRV flight tests, N_{TTS} is computed from the NMFS survey data by multiplying the overall probability of TTS ($P_{\text{OPAI@224}}$) impact by ANG, and dividing by P_{VDET} .

$$N_{\text{TTS}} = P_{\text{OPAI@224}} \frac{\text{ANG}}{P_{\text{VDET}}} \quad (14)$$

For ANG = 1, and $P_{\text{VDET}} = 0.1$,

$$N_{\text{TTS}} = \left[4.98(10^{-08}) \right] \left(\frac{1}{0.1} \right) = 4.98\text{E-}07$$

The number of groups of MMST that will likely suffer physical injury, N_{IT} is computed from the NMFS survey data using equation 15.

$$N_{\text{IT}} = P_{\text{OPAI@240}} \frac{\text{ANG}}{P_{\text{VDET}}} \quad (15)$$

$$N_{\text{IT}} = \left[2.41(10^{-08}) \right] \left(\frac{1}{0.1} \right) = 2.41\text{E-}07$$

in which $P_{\text{OPAI@240}}$ is the overall probability of physical injury impact.

4.5. Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Opportunistic Sighting Data Provided by the Department of Energy/Lawrence Livermore National Laboratory

The Department of Energy/Lawrence Livermore National Laboratory (DOE/LLNL) reported the opportunistic sighting of a porpoise, and a group of dolphins¹⁸ in the vicinity of Illeginni Island during two of its over 50 helicopter flights, and nearly 20 boat trips between Kwajalein and Illeginni Islands over a period of about 15 years.

The number of groups of MMST that will likely experience TTS, as a result of the proposed MMIIRV flight tests, N_{TTS} is computed from the DOE/LLNL opportunistic sighting data using equation 14.

$$N_{\text{TTS}} = P_{\text{OPAI@224}} \frac{\text{ANG}}{P_{\text{VDET}}} \quad (14)$$

For $\text{ANG} = 0.029$, and $P_{\text{VDET}} = 0.1$,

$$N_{\text{TTS}} = \left[4.98(10^{-08}) \right] \left(\frac{0.029}{0.1} \right) = 1.42\text{E-}08$$

The number of groups of MMST that will likely suffer physical injury, N_{IT} is computed from the DOE/LLNL opportunistic sighting data using equation 15.

$$N_{\text{IT}} = P_{\text{OPAI@240}} \frac{\text{ANG}}{P_{\text{VDET}}} \quad (15)$$

$$N_{\text{IT}} = \left[2.41(10^{-08}) \right] \left(\frac{0.029}{0.1} \right) = 6.89\text{E-}09$$

4.6. Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Survey Data Collected by the Marine Mammal Research Program, ATOC, for the Pacific Missile Range Facility EA, and Provided by the USASMDC

The MMRP of ATOC performed extensive aerial surveys of Hawaiian Waters during the period of 1993 through 1998 for the PMRF EA²²⁻²⁴. The USASMDC¹³ provided the PMRF survey data to ICBM SPO for analysis, and comparison with the results obtained from NMFS survey data for the proposed MMIIRV flight tests in the vicinity of Illeginni and KMISS Islands.

Estimates of TTS and physical injury impacts from two or more test sites may be compared to identify sites with the lowest risk, and to validate the assumptions made and the constraints applied in the development of a probabilistic impact model. In order to compare the impacts on marine mammals at the PMRF test site to the impacts at the Kwajalein Atoll test site, the average number of groups of MMST detected at PMRF test site must be multiplied by an area sizing factor (ASF) which is the ratio of the area of Kwajalein Atoll test site to the area of the PMRF test site. The surface area of the Kwajalein Atoll test site is 707 square miles, and the surface area of the PMRF test site is 36,644 square miles¹³. The ASF is 0.02.

The number of groups of MMST that will likely experience TTS as a result of the proposed MMIIIRV flight tests, N_{TTS} is computed from the PMRF aerial survey data by multiplying the overall probability of TTS ($P_{OPAI@224}$) impact by ANG and ASF, and dividing by P_{VDET} and SEF.

$$N_{TTS} = P_{OPAI@224} \frac{(ANG)(ASF)}{(P_{VDET})(SEF)} \quad (16)$$

For ANG = 21, $P_{VDET} = 0.1$, ASF = 0.02, and SEF = 0.446

$$N_{TTS} = [4.98(10^{-08})] \frac{(21)(0.02)}{(0.1)(0.446)} = 4.52E-07$$

The number of groups of MMST that will likely suffer physical injury, N_{IT} is estimated from the PMRF aerial survey data using equation 17.

$$N_{IT} = P_{OPAI@240} \frac{(ANG)(ASF)}{(P_{VDET})(SEF)} \quad (17)$$

$$N_{IT} = [2.41(10^{-08})] \frac{(21)(0.02)}{(0.1)(0.446)} = 2.19E-07$$

The PMRF survey data¹³, and the results of the acoustic impact analysis are summarized in Table 4.

4.7. Estimation of TTS and Physical Injury Impacts on Sea Turtles from the Survey Data Provided by the Fish and Wildlife Service Regional Office, Honolulu, Hawaii

Sea turtles are solitary animals, and hence, their group size is assumed to be one¹⁰. The number of groups of sea turtles is the same as the number of individual sea turtles. Sea turtles are submerged almost 90% of the time¹⁰, and the fraction of sea turtles available for visual detection during a survey is 0.1 which is the P_{VDET} used to compute the acoustic impact estimates.

Table 4. Results of the PMRF Survey Data Analysis

| Marine Mammals Sighted | No. of Groups Sighted | ANG | Corrected ANG | N _{TTS} | N _{IT} |
|---------------------------|-----------------------|-------|---------------|------------------|-----------------|
| Whales | | | | | |
| Short-finned pilot whale | 22 | 0.96 | 0.41 | 2.06E-08 | 9.97E-09 |
| False killer whale | 5 | 0.22 | 0.09 | 4.68E-09 | 2.27E-09 |
| Sperm whale | 6 | 0.26 | 0.11 | 5.62E-09 | 2.72E-09 |
| Blainville's beaked whale | 2 | 0.09 | 0.04 | 1.87E-09 | 9.06E-10 |
| Unidentified beaked whale | 4 | 0.17 | 0.08 | 3.75E-09 | 1.81E-09 |
| Culver's beaked whale | 1 | 0.04 | 0.02 | 9.36E-10 | 4.53E-10 |
| Humpback whale | 330 | 14.35 | 6.21 | 3.09E-07 | 1.50E-07 |
| Unidentified whale | 20 | 0.87 | 0.38 | 1.87E-08 | 9.06E-09 |
| Fin Whale | 1 | 0.04 | 0.02 | 9.36E-10 | 4.53E-10 |
| All Whales | 391 | 17.00 | 7.35 | 3.66E-07 | 1.77E-07 |
| Dolphins | | | | | |
| Spotted dolphin | 5 | 0.22 | 0.09 | 4.68E-09 | 2.27E-09 |
| Spinner dolphin | 17 | 0.74 | 0.32 | 1.59E-08 | 7.70E-09 |
| TG | 10 | 0.43 | 0.19 | 9.36E-09 | 4.53E-09 |
| Rough-toothed dolphin | 5 | 0.22 | 0.09 | 4.68E-09 | 2.27E-09 |
| Risso Dolphin | 2 | 0.09 | 0.04 | 1.87E-09 | 9.06E-10 |
| Unidentified dolphin | 38 | 1.65 | 0.71 | 3.56E-08 | 1.72E-08 |
| Unidentified Stenella | 7 | 0.30 | 0.13 | 6.56E-09 | 3.17E-09 |
| Bottlenosed dolphin | 8 | 0.35 | 0.15 | 7.49E-09 | 3.63E-09 |
| All Dolphins | 92 | 4.00 | 1.73 | 8.62E-08 | 4.17E-08 |
| All Mammals | 483 | 21.00 | 9.08 | 4.52E-07 | 2.19E-07 |

Very little direct data is currently available for TTS and physical injury impacts on sea turtles³⁰. The USFWS reported the sighting of a sea turtle²⁸ in the vicinity of Illeginni Island, during each of its two biannual inventories performed in years 1996 and 2002. On the basis of the assumption that the impacts of the proposed MMHVRV flight tests on sea turtles would be similar to the impacts on marine mammals, the TTS and physical injury impacts on sea turtles have been estimated from the USFWS survey data, using the same criteria established in Section 2.2 for the TTS and physical injury impacts on marine mammals. The number of sea turtles sighted per survey by USFWS is the same as the number of groups of sperm whales sighted per survey by NMFS, and hence, the estimated TTS and physical injury impacts of the proposed MMHVRV flight tests on sea turtles are the same as those for the marine mammals: N_{TTS} is 4.98E-07, and N_{IT} is 2.41E-07.

5. CONCLUSION

The criterion for TTS impact to MMST is 224 dB (equivalent to a total energy flux of 209 dB re 1 $\mu\text{Pa}^2\text{-s}$). The SPL generated by the disintegration of Minuteman III flight test RV at a depth of 7m from the surface of the ocean, is expected to attenuate to 224 dB at an AIR of 19.3m from the point of RV disintegration. The criterion for physical injury impact to MMST is 240 dB (equivalent to a total energy flux of 225 dB re 1 $\mu\text{Pa}^2\text{-s}$), and the SPL is expected to attenuate to 240 dB at an AIR of 3.1m from the point of RV disintegration. The volume of the AIW was calculated using a minimum radial distance of 15m rather than an AIR 3.1m computed using equation 4 for an SPL of 240 dB consistent with the rationale provided in Section 4.2. On the basis of these criteria and the rationale for the use of a minimum radial distance of 15m, the probabilities of TTS and physical injury impacts to MMST have been estimated to be 4.98E-08 and 2.41E-08. The number of sea turtles or the number of groups of marine mammals that may experience TTS, N_{TTS} has been estimated to be 4.98E-07, and the number of sea turtles or the number of groups of marine mammals that may suffer physical injury, N_{IT} has been estimated to be 2.41E-07. Despite the utilization of the same impact criteria for the marine mammals and the sea turtles, the TTS and physical injury impacts of the proposed MMIIIRV flight tests are considered to be less severe on sea turtles than on the marine mammals^{6,10,20,31,35}.

The N_{TTS} and N_{IT} estimates for the Kwajalein Atoll test site assure the United States Air Force (USAF), DOE/LLNL, USAKA, UASASMDC, FWS and NMFS that the impacts of the proposed MMIIIRV flight tests on MMST is quite insignificant. The assumptions made and the constraints applied in the definition of HW and AIW, and in the development of the probabilistic impact model, and the analytical approach utilized in the computation of the probabilities for the onset of TTS and physical injury impacts have been validated by the remarkably identical N_{TTS} (4.52E-07) and N_{IT} (2.19E-07) estimates obtained from the PMRF survey data. In addition, it is reassuring that the N_{TTS} (1.42E-08) and N_{IT} (6.89E-09) estimates computed from the DOE/LLNL opportunistic sighting data collected over the test site in the vicinity of Illeginni Island are an order of magnitude less than the N_{TTS} and N_{IT} estimates derived from the NMFS and PMRF survey data.

The maximum SPL²⁶ corresponding to the sonic boom associated with the Minuteman III flight test RV is 175.6 dB which is well below the TTS and physical injury impact criteria established in Section 4.2. The MMST may hear and respond (for instance, startle) to the RV disintegration at even greater radial distances corresponding to an SPL of 120 dB, but it is unlikely that an individual marine mammal or sea turtle would experience any more than a single, momentary disturbance^{10,31}. The radius of audibility is much greater than the radius of responsiveness to acoustic disturbances.

The limited amount of data available for sea turtles^{6,10,20,31} in the marine biological literature indicate that the impacts of the proposed MMIIIRV flight tests on sea turtles would be similar to the impacts on marine mammals. Hence, the TTS and physical injury impact criteria established for marine mammals are equally applicable to sea turtles.

In *Robertson v. Methow Valley Citizens Council*³⁶, The Supreme Court has declared that the sweeping policy goals of NEPA are realized through a set of “action-forcing” procedures that require the federal agencies to take a “hard look” at the environmental consequences of their proposed actions. The ICBM SPO has computed the probabilities of the TTS and physical injury impacts to MMST, and the number of sea turtles and the number of groups of marine mammals that may experience TTS and/or suffer physical injury, and carefully and objectively considered the consequences of the proposed MMIIIRV flight tests on MMST. The USAF and the ICBM SPO have made a serious, objective and good faith effort in estimating the acoustic impacts to MMST, and taken a “hard look” at the expected environmental consequences of the proposed MMIIIRV flight tests, and, on the basis of the analysis of currently available data, concluded that the impact on MMST at Kwajalein Atoll is quite insignificant.

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SYMBOLS

| | |
|---------------------------|--|
| D | Depth of the habitation well (250 m) |
| D_{MM} | Group density of MMST |
| d | Depth (AB) at which the RV is expected to disintegrate (6.9 m) |
| dB | Decibel |
| E_T | Total energy flux, $\mu\text{Pa}^2\text{-s}$ |
| N_{HW} | Number of groups of marine mammals in the habitation well |
| N_{IT} | Number of groups of marine mammals that will likely suffer physical injury |
| N_{RV} | Number RVs flight tested onboard a single Minuteman III missile. |
| N_{TTS} | Number of groups of marine mammals that will likely experience TTS |
| P | Pressure, Pa (Pascal) or μPa |
| μPa | Micropascal, $1\text{E-}6$ Pa |
| $\mu\text{Pa}^2\text{-s}$ | Squared micropascal times second |
| Pa-m | Pascal-meter |
| Pa-s | Pascal-second |
| $P - P_{inf}$ | Overpressure, Pa or μPa |
| P_{CPAI} | Compound probability of acoustic impact |
| P_{OPAI} | Overall probability of acoustic impact |
| $P_{IMP/AIW}$ | Conditional probability of acoustic impact given the fact that a group or a member of a group of marine mammals is already within the impact well. |
| P_{inf} | Ambient pressure, Pa |
| P_{ref} | Reference pressure for water, $\mu\text{Pa} = 1\text{E-}06$ Pa |
| P_{AIW} | Probability that a group or a member of a group is within the acoustic impact well |
| $P_{OPAI@224}$ | Overall Probability of TTS impact |
| $P_{OPAI@240}$ | Overall Probability of physical injury impact |
| P_{VDET} | The probability of visually detecting an MMST |
| R | Radius of the habitation well (24,140 m, 15 miles) |
| r | Radius of the acoustic impact well (BC = BE in Figure 1) |
| r_s | Surface radius (AE in Figure 1) of the impact well |
| S | Source strength of an intact MMIIIRV, Pa-m |
| t_{ref} | Reference duration, s |
| t_s | Length of time a group of MMST remains on the surface of the ocean |
| t_T | Average total length of time of a submergence/non-submergence cycle |
| t_+ | Duration of the positive phase of a pulse, s |
| V_{HW} | Volume of the habitation well ($4.58\text{E+}11 \text{ m}^3$) |
| V_{AIW} | Volume of the acoustic impact well, m^3 |

ABBREVIATIONS

| | |
|---------|--|
| AFB | Air Force Base |
| AFSPC | Air Force Space Command |
| AIR | Acoustic Impact Radius |
| AIW | Acoustic Impact Well |
| AME | Aerospace and Mechanical Engineering |
| ANG | Average Number of Groups (of marine mammals) |
| ASF | Area Sizing Factor |
| ATOC | Acoustic Thermometry of Ocean Climate |
| CFR | Code of Federal Regulations |
| DOD | Department of Defense |
| DOE | Department of Energy |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| EO | Executive Order |
| HW | Habitation Well |
| ICBM | Intercontinental Ballistic Missiles |
| IT | Incidental Take |
| KMISS | Kwajalein Missile Impact Scoring System |
| LLNL | Lawrence Livermore National Laboratory |
| MMIIIRV | Minuteman III RV |
| MMRP | Marine Mammal Research Program |
| MMST | Marine Mammals and Sea Turtles |
| NG | Number of Groups (of marine mammals) |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| PMRF | Pacific Missile Range Facility |
| PTS | Permanent Threshold Shift |
| RMI | Republic of Marshall Islands |
| RV | Reentry Vehicle |
| SEF | Survey Effectiveness Factor |
| SMC | Space and Missile Systems Center |
| SMDC | Space and Missile Defense Command |
| SPL | Sound Pressure Level, measured in dB |
| SPO | System Program Office |
| TTS | Temporary Threshold Shift |
| UES | USAKA Environmental Standards |
| US | United States |
| USAF | United States Air Force |
| USAKA | United States Army Kwajalein Atoll |
| USASMD | United States Army Space and Missile Defense Command |
| USFWS | United States Fish and Wildlife Services |
| USC | University of Southern California |

APPENDIX C

COMMENTS AND RESPONSES ON THE DRAFT ENVIRONMENTAL ASSESSMENT

**Comments and Responses on the
Draft Environmental Assessment for Minuteman III Modification**

A log of public and agency comment documents received on the Draft Environmental Assessment (EA) is provided below, and includes the document date, author, and his/her organization. A photocopy of each document can be found on the page number identified. Within most of the documents, comment numbers have been added along the right margins and are numbered sequentially. A corresponding list of comment responses, or a response letter, is provided immediately following each of the comment documents. Note that in addition to the comment responses, the text of the Final EA has also been revised, as appropriate, to reflect the concerns expressed in the comments.

Comment Documents Received

| Date | Author | Organization | Page |
|--------------------|---------------|---|-------------|
| September 29, 2004 | Doug Norlen | Pacific Environment | C-3 |
| September 30, 2004 | Tamra Faris | National Marine Fisheries Service, Pacific Islands Regional Office, Protected Resources Division | C-18 |
| November 5, 2004 | Gerald Davis | National Marine Fisheries Service, Pacific Islands Regional Office, Habitat Conservation Division | C-22 |
| November 17, 2004 | Gina Shultz | US Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office | C-25 |



Protecting
the living
environment
of the
Pacific Rim

September 29, 2004

SMC/AXFV

Attn: Leonard Aragon

2420 Vela Way, Suite 1467, El Segundo, CA 90245-4659

(via email: Leonard.Aragon@losangeles.af.mil)

Mr. Aragon,

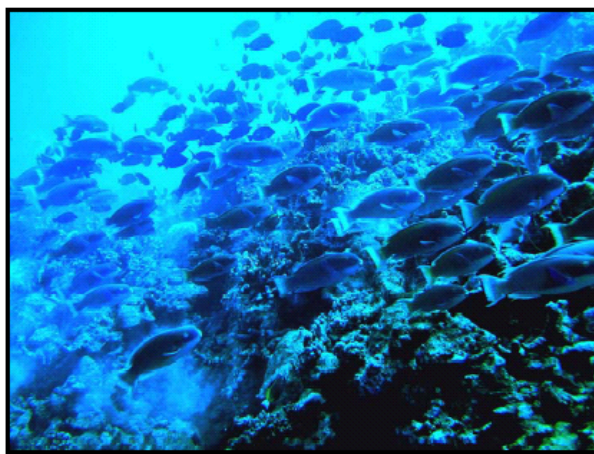
Pacific Environment has reviewed the Draft EA and Draft Finding of No Significant Impact (FONSI) for the Minuteman III Modification, and we submit the following comments for consideration.

Pacific Environment is an international Non Governmental Organization (NGO) that supports grassroots and community activism to achieve environmental and social protection and to promote sustainable development.

Pacific Environment respectfully disagrees with the conclusions of the Draft EA and FONSI that there will be no significant environmental and human health impacts of the proposed action on the environment of the Marshall Islands.

The Draft EA acknowledges the environmental importance of the down-range environment in question, including the Mid-Atoll Corridor:

The Mid-Atoll Corridor straddles Kwajalein Atoll, which is a crescent-shaped coral reef dotted with a string of approximately 100 islands that enclose the world's largest lagoon [1,100 square mi (2,849 square km)]. Lagoon depths are typically 120 to 180 ft (37 to 55 m), although numerous coral heads approach or break the surface. Ocean depths outside the lagoon descend rapidly, to depths as much as 13,000 ft (3,952 m) within 5 mi (8 km) of the atoll. The top of the Kwajalein Atoll reef (or reef flat) is intertidal. Natural passages through the reef flat allow passage of marine mammals, sea turtles, and other marine life to and from the lagoon.



Source: Naughton, 2004

(Picture of marine biodiversity contained in the Draft EA)

311 California Street, Suite 650 ■ San Francisco, CA 94104
tel. 415.399.8850 ■ fax. 415.399.8860 ■ www.pacificenvironment.org

The Draft EA acknowledges the presence of threatened, endangered and protected species in the area of Kwajalein Atoll, including whales, dolphins, turtles, clams, sponge and coral species, and migratory birds. The Draft EA acknowledges the biological diversity of the over-ocean corridor generally, including micro fauna, threatened and endangered species, protected marine mammals including seals, sea lions, sea otters, porpoises, dolphins, whales, and turtles. The Draft EA acknowledges the potential for direct impact on Illeginni Island or in the shallow coral reefs of Kwajalein, including impact on habitat of protected migratory birds, mollusks, sponges, corals, and other marine life; and damage small areas of migratory bird habitat, sea turtle nesting sites, and coral reef habitat. The Draft EA also acknowledges the importance of fish to people living in the area, who will be adversely affected by the proposed action:

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... 250 species of reef fish are located in the atolls of the Marshall Islands. Because food cultivation on the islands is limited, fish and other sea life are of important dietary value to the Marshallese people (Pacific Island Travel, 2002).

The Draft EA acknowledges that:

[R]esidual amounts of battery electrolytes, hydraulic fluid, propellant, and other materials in the spent rocket motors could lead to the contamination of seawater...

4

And,

Following an aerial detonation or impact of an RV in the ocean, the Kwajalein Atoll lagoon, and/or on Illeginni Island, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind.

However, the Draft EA is dismissive of potential impacts to these ecological and human resources with regards to contaminants to be released by the falling missile components. For example, it also states:

[T]he contaminants released by some RVs are extremely insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background levels.

5

Nowhere in the Draft EA is there data to indicate the rate of dilution and mixing of ocean and lagoon to support the conclusions of the Draft EA that battery electrolytes, hydraulic fluid, and other materials would be “no different than background levels.” In particular, no data is presented to indicate the rate of dilution and mixing in more shallow ocean, lagoon, and island habitats where debris may land.

6

Meanwhile, according to the Draft EA, the propellant to be used in the first, second and third stage motor is Ammonium Perchlorate, which is *absolutely not insoluble*. There is growing concern about the environmental and human

7

health impacts of Ammonium Perchlorate because it is highly toxic, soluble and persistent. Ammonium Perchlorate is a chemical that interferes with normal thyroid function, and persists indefinitely in the environment.¹ Ammonium Perchlorate has been documented as a contaminant at rocket manufacturing, testing, launching and disposal sites across the country, including Vandenberg.² In fact, in a 2001 memo that contained a list of known users and manufacturers of perchlorate, the EPA noted that at “essentially every listed facility where an effort has been made to test for perchlorate, perchlorate has been found in the soil or groundwater.”³ It is very reasonable to assume that Ammonium Perchlorate contamination will occur in the marine environment and terrestrial environment at the point of impact, downwind, and downstream of RV debris.

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According to the Draft EA:

When the spent rocket motors impact in the ocean, no solid propellant would be remaining in them. The residual aluminum oxide and burnt hydrocarbon coating the inside of the motor casings would not present any toxicity concerns.

Elsewhere, the Draft EA contradicts itself on the impacts of propellants:

[R]esidual amounts of hydraulic fluid and strontium perchlorate contained in the 1st- and 3rd-stage motors (respectively), may mix with the seawater, causing contamination. The release of such contaminants could potentially harm marine life that comes in contact with, or ingests, toxic levels of these solutions.

10

Hence, the Draft EA fails to adequately assess the potential impacts of Ammonium Perchlorate contamination and its conclusion of no significant impact is not grounded. The finding of perchlorate contamination at rocket launching and testing facilities as well as at open burn/open detonation sites both at military sites and private facilities throughout the US demonstrates that residual ammonium perchlorate propellant is not only likely to be present in the spent rocket motors, but that terrestrial and aquatic contamination from this propellant is likely.⁴

11

The Draft EA ignores the persistency of some hazardous material by suggesting potential impacts are short term:

The area affected by the dissolution of hazardous materials onboard would be relatively small because of the size of the rocket components and the minimal amount of residual materials they contain.

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¹ See <http://www.ewg.org/reports/rocketwater/>

² See <http://geotracker.swrcb.ca.gov/perchlorate/default.asp?cmd=detailedsite>

³ EPA Memorandum, “Perchlorate Contamination Update,” from Felicia Marcus, Regional Administrator, 2001.

⁴ Ibid #3

However, the words “small” and “minimal” are imprecise and misleading. Ammonium Perchlorate, for example, is hazardous in extremely small amounts. California’s current provisional drinking water standard is 6 parts per billion (ppb). The EPA’s current draft standard is equivalent to 1 ppb.⁵ If there is cause for concern with the human health impacts of small amounts of Ammonium Perchlorate, then there is also likely to be corresponding impacts to the marine and terrestrial environment, including protected migratory birds, mollusks, sponges, corals, and other marine life; and damage small areas of migratory bird habitat, sea turtle nesting sites, and coral reef habitat. This is especially true given that perchlorate is known to prevent forelimb emergence and tail resorption as well as altering the sex ratio in frogs at perchlorate levels (~ 150 ppb) similar to or lower than those found at many contaminated sites.⁶

12
(cont’d)

Meanwhile, the Draft EA describes the impact of a failed or terminated launch:

Initiating flight termination after launch would split or vent the solid propellant motor casing, releasing pressure and terminating propellant combustion. Pieces of unburned propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be dispersed over an ocean area of up to several square miles. Of particular concern is the ammonium perchlorate. Once in the water, it can slowly leach out of the solid propellant resin binding-agent.

The Draft EA describes such an event as “unlikely,” but elsewhere suggests “aerial detonation” of an RV as a source of dissemination of debris in the the Kwajalein Atoll lagoon, and/or on Illeginni Island. However, the Draft EA does not explain the intended practice of aerial detonation and whether it will occur when motor stages that contain Ammonium Perchlorate or other propellants are still present on the missile.

13

The Draft EA goes on to state that:

The overall concentration and toxicity of dissolved solid propellant from the unexpended rocket motors, or portions of them, is expected to be negligible and without any substantial effect. Any pieces of propellant expelled from a destroyed or exploded rocket motor would sink hundreds or thousands of feet to the ocean floor. At such depths, the material would be beyond the reach of most marine life.

Draft EA Figure 2-12 presents a poorly detailed map of where components of the missile will fall, but nevertheless indicates the third motor stage falling in the vicinity of the Utrick Atoll, which includes a number of islets and lagoon areas. If there is any possibility that the third stage could fall near or on the

14

⁵ Ibid #1

⁶ Goleman, WL, Urquidí LJ, Anderson, TA, Kendall, RJ, Smith, EE, Carr, JA. 2002. Environ Toxicol Chem. 21: 424-430

Utrick Atoll or any other island or shallow marine area, it is not adequately described or depicted in the Draft EIA.

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(cont'd)

Meanwhile, the Draft EIA describes additional components of the missile above the third stage that also contain propellant:

Just above the 3rd-stage motor on the MM III is the PSRE. It is a liquid propellant rocket unit consisting of two sealed propellant storage assemblies, a helium gas storage tank for pressurizing the propellant, and several small rocket engines. The propellants used are monomethylhydrazine (CH_6N_2) as the fuel, and nitrogen tetroxide (N_2O_4) as the oxidizer, which form a hypergolic combination.

And,

The nose cap on top of the shroud contains a small rocket motor containing 6.8 lb (3.1 kg) of solid propellant, which is used to eject the shroud from the vehicle while in flight.

According to the Figure 2-12 and other information in the Draft EA, these components will fall in the vicinity of the Kwajalein Atoll lagoon, and/or on Illeginni Island. Yet, there is no assessment of the impacts of these specific propellants on these environments or on human health.

The Draft Environmental Assessment acknowledges that the heavy metal beryllium (Be) and depleted uranium (DU) could be dispersed into the environment:

[D]epending on mission requirements, some of [the RV simulators] may contain varying quantities of hazardous materials, including high explosives, beryllium (Be), depleted uranium (DU), and batteries.

And,

Following an aerial detonation or ocean/lagoon impact by a test RV, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind. However, the Be and DU particles or fragments deposited by some RVs are very insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background levels.

Concerning land-based impacts (wildlife and human):

In view of the very low solubility and limited transport of Be and DU in soil and water, it is not likely that these materials would have any serious adverse effects on plants at Illeginni, or on the animals that might feed on those plants. Though there is the potential for migratory birds on the island to breath respirable dust particles of Be and DU, or consume particles deposited on vegetation, exposures (through breathing or feeding) to significant levels of these materials are not expected because of the small amount of unrecovered material that may persist in the environment.

15

And,

For the DU and Be, the deposition of small particles can contribute to elevated levels in soil in the immediate vicinity of the impact point and extend downwind.

And,

[A]n aerial burst or ocean/lagoon impact by some test RVs would disseminate onboard hazardous and toxic materials—primarily Be and DU—around the impact point and some distance downwind. For a land impact on Illeginni, such debris occurs close to the point of impact, mostly within a 328-ft (100-m) radius. As a result, the major potential health concern of these tests is the subsequent effects on USAKA workers, and other agency and contractor personnel, whose occupations require visits to the island, and the long-term management and restoration of the island.

Concerning marine impacts:

Fine particles would eventually be distributed in the sediment and be of no consequence to marine species, while any larger fragments would be recovered from the lagoon or from shallow ocean waters for proper disposal (see Section 4.5.4). (USAF, 1992a)

Beyond 164 ft (50 m) from the impact crater, under probable meteorological conditions, there is deposition on the water surface. The process of mixing Be and DU particles by tide and surf would rapidly dilute the small amounts deposited, and considering the low solubility of the Be and DU, resulting concentrations would be low and non-toxic to fish, sea turtles, coral, and other marine invertebrates along the reef. Eventually, the Be and DU are deposited as sediment, where they would slowly weather just as they do in the soil (USAF, 1992a). Thus, the overall health of the coral reef should not be affected.

Throughout these sections, the Draft Environmental Analysis concludes that there is no significant impact from DU contamination due to factors such as “small amounts” of unrecovered material, dilution, etc. Again, there is no data provided to substantiate dilution rates, particularly in shallow waters or on land.

Meanwhile, Table 4-7 presents an example of the amount of DU recovered in a previous launch, 176 pounds and 97 pounds for land and Atoll lagoon, respectively. However there are no figures indicating what percentage of total original DU this represents, and what amount of unrecovered DU remains. The Draft Environmental Assessment indicates that there could be considerable amounts remaining in small fragments or aerosolized, or simply debris unrecovered from the deep ocean:

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Because of the hypersonic velocity of RVs at impact, DU components are broken into small fragments and/or aerosolized. All of the Be-containing components are aerosolized because of the composition of the material; thus, no Be has been recovered. No attempts have been made to recover RV debris from deep ocean waters. (Lindman, 2004)

17
(cont'd)

The size of fragments, which are to be screened and removed manually, is left unclear, but what smaller fragments that remain appear to be buried in the soil, lagoon and ocean reefs by earthmoving equipment:

Post-test recovery operations at Illeginni Island require the manual cleanup and removal of any RV debris, including hazardous materials (e.g., DU), followed by filling in larger craters using a backhoe or grader...

18

And,

RV recovery/cleanup operations in the lagoon and ocean reef flats, within 500 to 1,000 ft (152 to 305 m) of the shoreline, are conducted similarly to land operations when tide conditions and water depth permit. A backhoe is used to excavate the crater. Excavated material is screened for debris and the crater is usually back-filled with coral ejected around the rim of the crater.

Again, the phrase “small amounts” of unrecovered material is imprecise and misleading. It is very likely that “small amounts” of DU can lead to significant harm to the environment and human health. Over the past twenty five years evidence of environmental and human health damage caused by DU has steadily increased, including significant evidence that DU can cause or accelerate cancer, mutate genes, and affect the kidneys, immune system, nervous system, respiratory system, and reproductive system. The United Nations Human Rights Commission considers DU munitions to be “weapons of mass destruction or with indiscriminant effect” incompatible with international humanitarian law.⁷

19

The Draft EA purports to evaluate the impacts of the proposed action on air quality. Yet, it does so only for the California portions of the proposed action, and even here it omits evaluation of airborne Ammonium Perchlorate. For the Marshall Islands portion of the proposed action, the Draft EA fails to evaluate air quality impact altogether, including from the potential airborne dissemination of battery electrolytes, hydraulic fluid, propellant, and other materials from falling stages or aerial detonation or impact from the falling RV. This includes DU and Be, which the Draft Environmental Assessment indicates will be aerosolized.

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⁷ “Depleted” Uranium Munitions, Nuclear Waste as a Weapon, Military Toxics Project Information Sheet, June 2003. See also: http://www.miltoxproj.org/DU/DU_Faqs/Du_Faqs.htm

The Draft EA correctly includes a section on cumulative effects. However, this section is framed as a *discussion* of cumulative effects, without much *assessment* of cumulative effects. For example:

The additional RV flight tests targeted within the Mid-Atoll Corridor could impact threatened and endangered sea turtles and marine mammals as a result of sonic boom overpressures, chemical release and water contamination, and direct contact and shock/sound wave from the splashdown of missile components. However, the relatively sparse distribution of marine mammals and sea turtles in the area makes the probability of significant adverse cumulative impacts on such species low.

21

Moreover, the cumulative effects section seems to be missing the point that small incremental effects (which the Draft EA acknowledges will occur), when combined with past effects may trigger significant cumulative effects that require an EIS. Instead, the Draft EA simply focus on the small incremental effects, disregarding the range of stressors that may already exist to each of the sensitive resources identified in each of the impact areas.

Thus, much of the cumulative impacts section reaches conclusions based on conjecture rather than assessment.

We are also concerned that the proposed action may be associated with a changed condition relates to the referenced incidental take permit/biological opinion, which triggers a requirement of re-consultation.

22

Conclusion:

Pacific Environment respectfully challenges the Draft Environmental Assessment finding of no significant impact (FONSI).

23

Commendably, the Draft Environmental Assessment does a good job to describe the importance of natural and human environment including marine and terrestrial biodiversity, threatened, endangered and protected marine and bird species, and fish resources in the Marshall Islands region. The Draft Environmental Assessment acknowledges contamination of hazardous material including battery electrolytes, hydraulic fluid, propellant, beryllium, and depleted uranium. However, the Draft Environmental Assessment fails to accurately or completely assess the environmental impacts of the proposed action for the following reasons:

- Inadequate description of the proposed action, including “aerial detonation;”
- Poor description of location of falling components;
- Inadequate or no data to base claim that the expected contamination is not significant;

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| • Internally contradictory statements about potential for impacts from propellants; | 27 |
| • Inadequate assessment of potential impact of Perchlorate | 28 |
| • No assessment at all of other propellants, including monomethylhydrazine (CH ₆ N ₂) and nitrogen tetroxide | 29 |
| • Inadequate assessment of impacts of Depleted uranium and beryllium | 30 |
| • Inadequate assessment of air quality impacts | 31 |
| • Inadequate cumulative affects analysis | 32 |
| • Change of condition that requires re-consultation related to incidental take permit/biological opinion. | 32 |

| | |
|---|----|
| As a consequence, we believe that there is inadequate basis for a finding of no significant impact (FONSI), and that a full Environmental Impact Statement is required. | 33 |
|---|----|

RESPONSES TO PACIFIC ENVIRONMENT COMMENTS (9/29/04)

Response to Comment #1

It is acknowledged that Pacific Environment disagrees with the conclusions of the Draft EA and Draft FONSI.

Response to Comment #2

As described in Section 4.5.1 of the EA, the potential for RV impacts on Illeginni Island or in coral reef areas is very low (estimated to be four to five instances over a 20-year period). No significant impacts to biological resources are expected.

Response to Comment #3

The EA does acknowledge the importance of fish to the Marshallese people; however, the comment that people living in the area will be adversely affected by the proposed action is false. There are no people living on or near Illeginni Island, or near any of the lagoon or ocean areas where RVs would impact. Because only a few RV tests would occur each year, and only small areas would be affected with each test, fish populations would not be impacted.

Response to Comment #4

See responses to Comments #6, #9, and #10.

Response to Comment #5

The commentator's quote from the EA "The contaminants released by some RV's are extremely insoluble..." is not entirely correct. The insolubility statement only applies to DU and Be. Chapter 4 of the Draft EA makes that statement in several places that "the DU and Be particles or fragments deposited by some RVs are very insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background levels." Studies cited in Section 4.5.1.1 of the EA support this finding. Analyses of potential impacts from DU and Be particles on the ecological environment and human health are discussed in Sections 4.5.1 and 4.5.3 of the EA, respectively. See also the response to Comment #6.

Response to Comment #6

Though dilution rates for the battery electrolytes, hydraulic fluid, and other materials carried onboard the spent rocket motors and test RVs have not been determined, the relatively small quantities are expected to be well dispersed and diluted once the missile components impact the water. For example, Section 4.5.1.1 points out that the individual RVs impacting at USAKA would contain no more than 2.13 ounces of potassium hydroxide and about 0.2 pounds of lithium compounds. On land or within the shallow waters at USAKA, battery fragments would be recovered as part of post-test cleanup operations. For discussion on the DU and Be materials carried on some RVs, refer to the response to Comment #5.

In regards to the hydraulic fluid, the 1st-stage rocket motor thrust vector control system contains several gallons of the fluid. As described in Section 2.2.3 and shown on Figure 2-10 of the EA, the spent 1st-stage rocket motor would impact in the open ocean approximately 110-160 miles off the California coast. Though the hydraulic fluid could leak into the water, it would not result in significant impacts (see Section 4.4.1 of the EA). As explained in Section 2.1.1, no other Minuteman III missile components (including the test RVs) contain hydraulic fluid.

Response to Comment #7

It is acknowledged that the three rocket motor stages used for the Minuteman III missile contain a solid propellant, which includes ammonium perchlorate as one of the chemical components (see Table 2-1 in

the EA). It is also true that ammonium perchlorate is not insoluble in water. This point is explained in Section 4.3.3.1 of the EA.

Response to Comment #8

As described in Section 3.3 of the EA, prior Installation Restoration Program (IRP) studies at Vandenberg AFB have not shown any concerns for contamination to soils or groundwater from prior launches in the Minuteman Launch Area. However, the Vandenberg AFB IRP did discover perchlorate contamination at the “Site 8 Cluster”, which is Space Launch Complex (SLC) 4 on South Base, located approximately 14 miles south of the Minuteman Launch Area. Perchlorate levels up to 500 parts per billion (ppb) were detected at this site. This facilitated installation of a perchlorate removal system at SLC-4. The contaminants resulted from prior launch activities at this site.

Except for SLC-4, there are no other known perchlorate contamination sites on base. However, at the request of the California Environmental Protection Agency, Central Coast Regional Water Quality Control Board, a basewide preliminary assessment was recently initiated. This assessment will conduct a historical search and identify any likely sites for perchlorate contamination. The Minuteman launch facilities on North Base are included in this effort. Soil and/or groundwater sampling will be conducted at identified sites as required. This effort will be completed in late FY05.

Response to Comment #9

The statement about perchlorate and RVs is false. As described in Section 2.1.1, the 1st-, 2nd-, and 3rd-stage rocket motors, and the small Reentry System shroud ejection motor, are the only Minuteman III missile components containing solid propellant with ammonium perchlorate. Following launch, each of the three main rocket motors would be expended by the time they impact in the open ocean; therefore, no propellants (or perchlorate) would be expected to enter the water (see Section 4.4.1.1 of the EA). The shroud ejection motor would also be spent early in flight and, should the motor casing survive atmospheric reentry, would not cause any perchlorate contamination in the ocean. Neither the post-boost vehicle, nor any of the test RVs, contains solid propellant or any other forms of perchlorate.

Response to Comment #10

The hydraulic fluid and strontium perchlorate are used in the rocket motor thrust vector control systems. They are not a component of the solid propellant (see Section 2.1.1 of the EA). Though small quantities of these fluids (i.e., up to several gallons of hydraulic fluid and up to several pounds of strontium perchlorate) could leak into the water following motor impact in the open ocean, they would not result in significant impacts (see Section 4.4.1 of the EA).

Response to Comment #11

Though ground “testing facilities as well as at open burn/open detonation sites” may have proven to be sources of perchlorate contamination at some locations (i.e., locations not associated with the proposed Minuteman III Modification), Minuteman III launches have not been identified as a source of such contamination. See also responses to Comments #8 and #9.

Response to Comment #12

The EA does not ignore the persistency of hazardous materials. For example, on Illeginni Island, long-term monitoring of DU and Be from prior RV tests has not shown little or no buildup of contaminants. As described in Sections 4.5.3.1 and 4.5.4.1, prior sampling has shown that levels of contaminants in the air continue to remain at or near background levels. Because no missile components containing solid propellants would impact in the vicinity of the Marshall Islands, there is no means for ammonium perchlorate to be introduced to the islands under the Proposed Action. As noted in the response to Comment #9, the expended rocket motors would not contain any propellant when they impact in the open

ocean. Thus, no sea turtle nesting sites or reef habitat would be affected by ammonium perchlorate. See also responses to Comments #6 and #10.

Response to Comment #13

As described in Sections 4.3.3.1 and 4.4.1.1, a system failure during launch or an early termination of flight would terminate propellant combustion, and potentially disperse solid propellant over a large area. For impacts at Vandenberg AFB, procedures are in place to recover unburned propellant from land and shallow waters (Sections 4.3.3.1 and 4.3.5.1 of the EA), thus, preventing the potential for perchlorate to be released into the soil or groundwater. For impacts in deeper ocean waters, perchlorate leachate concentrations from unburned propellant are not expected to accumulate to a level of concern (see Section 4.4.1.1 of the EA).

As explained in Section 2.2.4 of the EA, RV tests at USAKA do not include rocket motors. As previously noted in responses to Comments #9 and #12, there is no means of introducing ammonium perchlorate to the USAKA environment under the Proposed Action.

Response to Comment #14

USAF and USAKA flight safety requirements specify that missile components and related debris are not to impact on or in the vicinity of inhabited atolls and islands, including Utrick Atoll. Artificial protection boundaries around these land areas are used to ensure the safety of inhabitants of the Marshall Islands. As depicted in Figure 2-12 of the EA, the spent third-stage motor would impact in deep ocean waters far from most land areas.

Response to Comment #15

First, it is important to clarify that neither the PSRE, nor the nose shroud (including the shroud ejection motor), would impact in the vicinity of the Kwajalein Atoll lagoon and/or on Illeginni Island. The nose shroud (with motor) is ejected early in flight and, should it survive atmospheric reentry, would impact in the open ocean approximately 1,000 miles northeast of the Hawaiian Islands (see also response to Comment #9). The PSRE is part of the post-boost vehicle (see Section 2.1.1 of the EA), which impacts in open ocean waters northeast of USAKA (see Figure 2-12 in the EA). As explained in the previous comment response, inhabited atolls and islands are protected from falling missile components and related debris. In the case of USAKA, a missile impact corridor is established across the atoll for each MM III flight test. The safety precautions used in setting up the Mid-Atoll Corridor are explained in Sections 2.2.4 and 3.5.3 of the EA.

In regards to the PSRE and liquid propellants, impact analysis discussions have been added to the EA in Sections 4.3.3 and 4.4.1. Since most of the liquid propellants are consumed during normal flight, this is primarily an issue that would occur during a launch failure or early flight termination. The probability for such an occurrence is extremely low.

As for the shroud ejection motor and solid propellants, refer to the response for Comment #9.

Response to Comment #16

On Illeginni Island, long-term monitoring of DU and Be from prior RV tests have shown little or no buildup of contaminants. As described in Sections 4.5.3.1 and 4.5.4.1 of the EA, prior sampling has shown that levels of contaminants in the air continue to remain at or near background levels. Though soil concentrations of Be and DU, in the vicinity of RV impacts on the island, can occur above background levels, their concentrations in the dissolved form are below background levels. In addition, the rates of dilution for Be and DU are significantly greater than their rates of dissolution in water, ensuring that the concentrations would not exceed background levels. To help confirm this finding, sampling efforts on land and in the shallow waters at Illeginni Island were conducted during the summer of 2004. Once

analysis of the samples is complete, the information will be used in determining the need for further consultations with the USFWS, NMFS, USEPA, and RMIEPA (see Section 4.5.1.1).

Response to Comment #17

The amount of materials presented in Table 4-7 of the EA represents totals for all RV impacts in the vicinity of Illeginni Island during the period 1990 to 2003; not totals for a single RV test. Good faith efforts have been made in prior recovery operations, and will continue to be made for future RV tests to ensure unrecovered debris remains at a level of insignificance. The requested information regarding quantities of DU cannot be incorporated into the EA without compromising the security interests of the USAF and the US Government.

Response to Comment #18

During RV recovery operations, various tools are used to locate and collect visible size debris particles that are a few millimeters and larger in diameter. Because of the extreme forces exerted during airburst tests and surface impacts, much of the unrecovered debris is dispersed as an aerosol. See also the responses to Comments #16 and #19.

Response to Comment #19

As previously mentioned, the quantities of DU in question cannot be incorporated into the EA without compromising the security interests of the USAF and the US Government. Though some RV debris materials are not recovered, prior monitoring efforts at Illeginni Island have shown little or no buildup of contaminants (refer to Sections 4.5.1 and 4.5.3 of the EA).

In terms of health risks, DU is not a significant health hazard unless it is taken into the body. External exposure to radiation from DU is generally not a major concern because the alpha particles emitted by its isotopes travel only a few centimeters in air, or can be stopped by a sheet of paper. Also, the uranium-235 that remains in DU emits only a small amount of low-energy gamma radiation. If allowed to enter the body, such as through ingestion or inhalation, DU does have the potential for causing both chemical and radiological toxicity, depending on the level and duration of exposure.¹ However, at Illeginni Island, the observed minute concentrations of residual DU from prior RV tests do not present a significant health risk.

For future RV testing, air and soil monitoring for DU will continue, as specified by the mitigation measures described in Section 4.7 of the EA. The monitoring results will be submitted to the USAKA Environmental Management Office and forwarded to the RMI Government, as required.

Response to Comment #20

During launch of the Minuteman III missile from Vandenberg AFB, combustion of the solid rocket propellant converts the ammonium perchlorate (NH₄ClO₄) primarily into nitrogen oxides (NO_x), hydrogen chloride (HCl), and water (H₂O); not “airborne ammonium perchlorate.” For further discussions on rocket emissions, refer to Section 4.3.1 of the EA.

As for air quality in the Marshall Islands, the EA does assess the dispersal of DU and Be particles into the air in Section 4.5.3 of the EA. As explained in the response to Comments #6, hydraulic fluid is only used in the Minuteman missile 1st-stage motor, which splashes down in the open ocean off the California coast. No hydraulic fluid is released into the atmosphere during launch. Some residual liquid propellants are likely to remain in the post-boost vehicle when it impacts in the open ocean northeast of USAKA;

¹ US Department of Energy, Argonne National Laboratory (<http://web.ead.anl.gov/uranium/guide/depleteddu/health/index.cfm>); see also http://www.defenselink.mil/news/Oct2004/n10192004_2004101903.html.

however, these materials would not be dispersed in the air. Regarding battery electrolytes dispersed during RV airbursts or land impacts at USAKA, very small quantities of electrolyte materials (no more than 2.13 ounces of potassium hydroxide and about 0.2 pounds of lithium compounds) might be released into the air, if they survive at all.

Response to Comment #21

Especially for Vandenberg AFB and USAKA, the EA properly assesses the proposed action, in conjunction with other actions having similar impacts, to determine cumulative effects. As described in Section 4.6 of the EA, the addition of two Minuteman III flight tests from Vandenberg AFB in FY 2005 and in FY 2006 would not present a substantial increase in current launch rates. At USAKA, the number of RVs tested would significantly decrease after FY 2005 (see Table 4-9). As Section 4.6 explains, years of RV testing at USAKA have caused minimal long-term affects, if any. In particular, at Illeginni Island, the native vegetation and migratory bird populations continue to thrive, and the coral reef habitat remains diverse and generally in good health.

Response to Comment #22

As explained in Section 4.3.3.1 of the EA, Vandenberg AFB currently has an incidental take permit in place for pinnipeds. No changes to this permit are anticipated.

At USAKA, no incidental take permit is currently in place for RV testing. However, as is explained in the recent USFWS Biological Opinion (see Appendix A of the Final EA), an incidental take statement for green sea turtle nests will apply to future RV tests. Also, as part of the Document of Environmental Protection process explained in Section 1.7 of the EA, the USAF will continue coordination and consultation with USAKA, USFWS, NMFS, and the RMIEPA.

Response to Comment #23

It is acknowledged that Pacific Environment disagrees with the Draft EA finding of no significant impact.

Response to Comment #24

More descriptive information on RV airburst tests has been added to Section 2.2.4 of the Final EA.

Response to Comment #25

More information regarding falling missile components is provided in the responses to Comments #14 and #15.

Response to Comment #26

Sufficient information and data used to analyze potential soil, air, and water contamination is provided in the appropriate sections of Chapter 4 of the EA.

Response to Comment #27

No contradictory statements about potential impacts from propellants have been identified in the EA.

Response to Comment #28

An assessment of potential impacts from perchlorate is provided in Sections 4.3.3 and 4.4.1 of the EA. See also responses to Comments #9, #12, and #20.

Response to Comment #29

See response to Comment #15.

Response to Comment #30

An assessment of potential impacts from DU and Be is provided in Section 4.5 of the EA. See also responses to Comments #5, #12, #16, and #19.

Response to Comment #31

A detailed assessment of potential air quality impacts at Vandenberg AFB is provided in Section 4.3.1 of the EA. A focused assessment of potential air quality impacts at USAKA is included in Section 4.5.3. See also the response to Comment #20.

Response to Comment #32

See the response to Comment #22.

Response to Comment #33

The USAF has determined that a finding of no significant impact is appropriated for the Proposed Action, and that an EIS is not required.



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1601 Kapiolani Boulevard, Suite 1110
Honolulu, Hawaii 96814-0047

C/AXFV, Attn: Leonard Aragon
2420 Vela Way, Suite 1467
El Segundo, CA 90245-4659

SEP 30 2004

RE: Comments on Draft Environmental Assessment for Minuteman III Modification
(dated August 2004)

Dear Mr. Aragon:

This letter responds to your request, received August 27, 2004, for comments on the Draft Environmental Assessment for Minuteman III Modification (dated August 2004). The National Marine Fisheries Service, Pacific Islands Regional Office, Protected Resources Division is pleased to provide the following comments and information under our statutory authorities under the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*) and the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. §1361 *et seq.*)

General Comments

- The discussion of factors involved in inducing temporary threshold shift (TTS) should more clearly consider the role of exposure duration as well as level. The Finneran et al. (2002) paper referred to in the text does a very nice job of considering the various exposure variables, including peak pressure and energy flux density. It is the interaction of exposure level and duration that is critical in terms of auditory fatigue. The Environmental Assessment (EA) would be improved with a more explicit consideration of this and its bearing on the potential impacts of the sorts of exposures (very brief) generated by sonic booms produced by the reentry vehicle (RV) impacts. A comparison with the Nachtigall et al. (2003) exposure levels and durations will emphasize the point that much higher exposure levels are needed when the duration of exposures is so weak. A translation of the pressure levels given into energy units would be both useful in considering the EA and consistent with the approach increasingly taken regarding exposure to other military sources. Using the longest potential exposure durations (within reason) would be the advisable conservative manner to estimate received energy flux density values.
- The EA fails to consider possible behavioral reactions to either RV overflight during re-entry or sounds produced by impact. It is almost certain that exposed animals will experience behavioral disturbance at levels below those sufficient to induce TTS. While cetaceans seem to be much less impacted by aerial human activities that do breeding pinnipeds, for instance, there is a considerable literature regarding disturbance from airborne activities in cetaceans (see Richardson et al., 1995) that should be considered. It is very likely that behavioral reactions to overflight would be both brief and not biologically significant, but this should be discussed. Similarly,

1

2



some reasonably conservative means of estimating behavioral disturbance from impacts should be added to this consideration. Potentially affected species include not only cetaceans but also marine turtle and seabird populations. These groups of animals receive much less consideration in terms of hearing impacts (and none in terms of behavioral disturbance as well) than the cetaceans.

2
(cont'd)

Specific Comments

- The reference to Kastak et al. (1999) on p. 85, fourth paragraph is not the most appropriate reference. For a general statement like this containing many other sources and explicit discussion of the range of behavioral reactions, Richardson et al (1995) would be better. **3**
- Page 85, fifth paragraph, first sentence (“...mild TTS do not cause permanent...and presumably do not do so in marine mammals.”) References could be made to the Kastak et al. (1999) study as well as Schlundt (2000); Finneran et al. (2000; 2002); and Nachtigall (2003) and the word “presumably” can be eliminated. There has been sufficient demonstration of TTS in both cetacean and pinniped subjects to know this to be true, at least for the marine mammal species tested. **4**
- Page 85, fifth paragraph, second sentence (“However, very prolonged exposure to sound strong enough to cause a TTS...” overstates current understanding of the relationship between TTS and permanent threshold shift (PTS), even for terrestrial mammals. Asymptotic TTS at low levels (<10 decibels (dB)) even for many days of exposure can be fully recoverable in some species, and in most species tested, over 40 dB of TTS (which would have to be considered well above the TTS onset threshold) is fully recoverable in some conditions. The basic point of the sentence is accurate, but it needs to be more precisely worded (and referenced). Also, the point of the phrase “at least in terrestrial mammals” should be more explicitly made – i.e., that there is no data on PTS in marine mammals. **5**
- While this distinction has no bearing on this EA due to the absence of pinnipeds in the operation area, there should be some indication that cetacean and pinniped TTS onset points appear to be quite different (compare results of all above references – a recent presentation by Finneran at the Marine Mammal Commission meetings (which is available at mmc.gov) lays this out quite clearly.) Were the EA ever to be expanded to include impacts at higher latitudes where pinniped populations occur, the conclusions will need to be revisited. For accuracy, the EA should note that these criteria for cetaceans are based on cetacean data and not necessarily applicable to other groups of marine mammals, including pinnipeds and other cetacean groups for whom there are no hearing data or information regarding noise impacts on hearing (e.g., mysticetes). The wording should be more precise and restrictive to the information currently available. **6**

References not included in the EA

Below are references that should be included in the discussion of impacts in the Draft EA, referenced in the above comments:

7

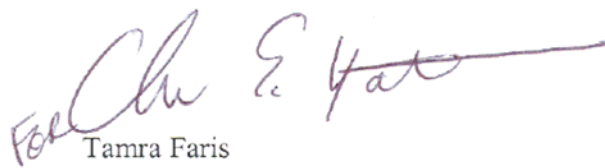
Nachtigall, P. E., J. L. Pawloski, and W. W. L. Au. 2003. Temporary threshold shifts and recovery following noise exposure in the Atlantic bottlenosed dolphin (*Tursiops truncatus*). Journal of the Acoustical Society of America 113, 3425-3429.

Richardson, W. J., C. R. Greene, C. I. Malme, and D. H. Thomson (Eds.) 1995. Marine mammals and noise. (Academic Press, New York).

Schlundt, C. E., J. J. Finneran, D. A. Carder, and S. H. Ridgway. 2000. Temporary shift in masked hearing thresholds of bottlenose dolphins and white whales after exposure to intense tones. *Journal of the Acoustical Society of America* 107, 3496-3508.

We appreciate the opportunity to provide comments to you on this Draft EA. Please do not hesitate to contact me at (808) 973-2937 to discuss these comments further.

Sincerely,

A handwritten signature in purple ink, appearing to read "For Chu E. Yates", is written over the printed name of Tamra Faris.

Tamra Faris
Assistant Regional Administrator
Protected Resources Division

RESPONSES TO NATIONAL MARINE FISHERIES SERVICE COMMENTS (9/30/04)

Response to Comment #1

Clarification of the exposure duration and exposure variables, in association with TTS, has been made in Sections 4.4.1.1 and 4.5.1.1 in the form of footnotes and some additional text. This includes a comparison with longer exposure levels as documented by Nachtigall et al. (2003). Based on the longest estimated exposure duration, energy flux density values for shock/sound waves from RV impacts have been calculated and added to Section 4.5.1.1 (Table 4-6) for comparison purposes. Equivalent underwater energy flux density values for sonic booms and spent rocket motor impacts were not included because of the very short durations and minimal potential for biological impacts from those actions.

Response to Comment #2

Behavioral reactions in birds from sonic booms are already addressed in Section 4.5.1.1 of the EA. A brief discussion on reactions in birds from RV impacts has been added to this same section.

Detailed discussions on behavioral reactions in marine mammals (primarily cetaceans) have been added to Sections 4.4.1.1 and 4.5.1.1 of the EA, with reference to both Richardson et al. (1995) and Schlundt et al. (2000). Brief discussions on impacts to sea turtles were included.

Response to Comment #3

The discussion on behavioral reactions has been modified in Section 4.5.1.1 of the EA, per information provided in Richardson et al. (1995).

Response to Comment #4

Citations for Finneran et al. (2002), Kastak et al. (1999), Nachtigall et al. (2003), and Schlundt et al. (2000) have been added to the paragraph, and the word “presumably” has been deleted from the first sentence.

Response to Comment #5

A new paragraph has been added to this discussion (Section 4.5.1.1 in the EA) to help clarify the relationship between TTS and PTS, especially for terrestrial animals. The new discussion includes the point that data on PTS in marine mammals is not available. Appropriate references have been cited.

Response to Comment #6

Applicability of the TTS criterion (224 dB ref to 1 micropascal) has been clarified with some added text and footnotes in both Sections 4.4.1.1 and 4.5.1.1 of the EA. Because comparable data for other cetacean groups [e.g., mysticetes (baleen whales)] and some other marine mammal groups [e.g., sirenians (including dugongs)] are not available, the analysis conducted in the EA assumed that the TTS data collected for small odontocetes is applicable to other whale species and dugongs occurring within the open ocean and/or at USAKA.

Though data cited in Comment #6 (available at <http://www.mmc.gov/sound/plenary2/plenary2.html>) does show some differences in underwater hearing sensitivities between cetaceans and pinnipeds, specific reference to pinnipeds was not made in either Sections 4.4.1.1 or 4.5.1.1 of the EA because pinnipeds have little or no bearing on the analysis in the open ocean or at USAKA. However, should similar underwater analyses be required in areas where pinnipeds typically occur, it is agreed that different TTS criteria may be needed.

Response to Comment #7

References to Nachtigall et al. (2003), Richardson et al. (1995), and Schlundt et al. (2000) have been added to Section 4.4.1.1 and/or Section 4.5.1.1 of the EA, per earlier comment responses.



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
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November 5, 2004

SMC/AXFV, Attn: Leonard Aragon
Los Angeles Air Force Base
2420 Vela Way, Suite 1467
El Segundo, CA 90245-4659

**Subject: DRAFT ENVIRONMENTAL ASSESSMENT FOR MINUTEMAN III
MODIFICATIONS**

Dear Mr. Aragon:

The National Marine Fisheries Service (NMFS), Pacific Islands Regional Office, Habitat Conservation Division (HCD) has received the Draft Environmental Assessment (EA) for Minuteman III Modifications prepared by the United States Air Force, dated August 2004. NMFS, HCD has reviewed the Draft EA, as well as the Notice of Proposed Activity (NPA) for the project, and offers the following comments for your consideration.

NMFS has been involved in the review of the proposed modifications to the Minuteman III program for over a year. We submitted comments on the Agency Coordinated Draft EA dated 13 November 2003. Concerns in these comments relating to marine resources and habitats at US Army Kwajalein Atoll (USAKA) were included in the subject Draft EA. In addition, NMFS has met on several occasions with the US Air Force and US Army SMDC to further discuss potential project impacts in the Illeginni Island region of USAKA, as well as mitigation measures to compensate for these potential impacts.

In view of the early coordination process, NMFS believes that the near shore marine resources and habitats in the project area, as well as potential impacts to these resources, are adequately addressed in the Draft EA. NMFS also concurs with the proposed compensatory mitigation measures described in the EA (Sections 4.5.1 and 4.7), which were initiated in consultation with NMFS and USFWS. We believe it is critical that these mitigation measures are further developed in consultation with the resource agencies, and implemented as soon as possible in order to validate the project Finding of No Significant Impact (FONSI). Of particular importance to NMFS are the following mitigation measures:

1



1. Protocols must be developed in conjunction with the resource agencies to determine which RV impact craters on the reef flats at Illeginni should be filled, and which should be left unfilled in order to avoid further damage to the coral reef ecosystem of Kwajalein Atoll.

2

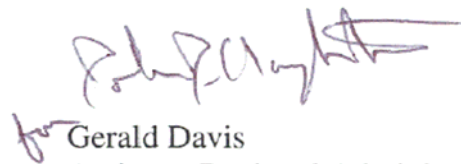
2. The marine and terrestrial compensatory mitigation protected area at Eniwetak Island (east side of Kwajalein Lagoon) must be defined and delineated in conjunction with the resource agencies, and established as soon as possible.

3

The NMFS, Pacific Islands Regional Office, Protected Resources Division (PRD) is also in the process of reviewing the Draft EA and NPA. PRD submitted initial comments date 30 September 2004. Additional comments concerning mitigation for NOAA trust protected resources at USAKA will be submitted shortly.

NMFS, HCD appreciates the opportunity to comment on the subject Draft EA and NPA, as well as the early coordination on the Minuteman III project. Should you have any questions on these comments, please contact John Naughton, Pacific Islands Environmental Coordinator at NMFS in Honolulu (808/973-2935 x 211).

Sincerely,

A handwritten signature in purple ink, appearing to read "John Naughton", is written over the typed name "Gerald Davis".

Gerald Davis
Assistant Regional Administrator
Habitat Conservation Division

RESPONSES TO NATIONAL MARINE FISHERIES SERVICE COMMENTS (11/5/04)

Response to Comment #1

As described in Section 4.7 of the EA, “the USAF will continue coordination and consultation with USAKA, the USFWS and NMFS Pacific Islands Regional Offices in Hawaii, and the RMIEPA to clarify current mitigation measures and determine whether any additional mitigation measures are warranted.” The USAF is committed to working with the appropriate agencies on the implementation of these mitigation measures.

Response to Comment #2

Mitigation measure #13 in Section 4.7 of the EA, regarding the development of protocols for filling in craters, has been modified to include consultation with the appropriate agencies. It is expected that the protocols will initially be developed during consultations for the DEP.

Response to Comment #3

Regarding Eniwetak Island, mitigation measure #15 in Section 4.7 of the EA has been rewritten to better emphasize the USAF commitment to supporting establishment of a protected area for sea turtle nesting and coral reef habitat.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
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In Reply Refer To:
PN-04-253

NOV 17 2004

Leonard Aragon
2420 Vela Way
Suite 1467
El Segundo, CA 90245-4659

Re: Draft Environmental Assessment for Minuteman III Modification.

Dear Mr Aragon,

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft Environmental Assessment (DEA) for the above referenced action. The DEA was prepared by Acquisition Civil and Environmental Engineering Space and Missile Systems Center, Los Angeles Air Force Base, California. The proposed project is sponsored by the ICBM System Program Office, Ogden Air Logistics Center, Hill Air Force Base, Utah. The following comments pertain only to project-related activities planned for U.S. Army Kwajalein Atoll (USAKA) in the Republic of the Marshall Islands. These comments have been prepared pursuant to the National Environmental Policy Act of 1969 [42 U.S.C. 4321 *et seq.*; 83 Stat. 853] and other authorities mandating Service concern for environmental values, including the USAKA Environmental Standards (UES). Since the DEA also serves as a Notice of Proposed Activity (NPA) for a USAKA Document of Environmental Protection for the Proposed Action, this letter also transmits the Service's Environmental Comments and Recommendations on the NPA per UES requirements.

The proposed project involves conducting flight tests of Minuteman III missiles, which have been modified with new Mark 21-related hardware and software. Flight tests involve missile launches from Vandenberg Air Force Base (AFB), California, to target locations at USAKA. The missile is comprised of three stages, which will separate from the reentry vehicle (RV) and land in the ocean. RVs are anticipated to land at designated targets at Kwajalein Atoll including deep ocean sites, shallow marine reef flat sites adjacent to Illeginni Islet, and terrestrial sites on Illeginni Islet or be aerially detonated. A total of nineteen tests would be conducted between 2005 and 2010. The DEA evaluates a Proposed Action, which includes the preferred proposed modifications of the Mark 21 RV, and a No-Action Alternative.

GENERAL COMMENTS

We have worked closely with USAKA and the Air Force during scoping and early review of the proposed project, including coordination on the mitigation measures identified in the DEA. Our primary concerns with the proposed action are regarding the analysis of anticipated project-

related impacts to significant USAKA species and habitats and with the proposed mitigation measures that are intended to minimize fish and wildlife impacts and compensate for project-related resource losses at Illeginni Islet.

With regard to the impact analysis, the DEA presents little relevant information on which to base a sound analysis for significant protected species at USAKA. For example, the DEA does not provide information on (1) the densities of species protected under the UES in the affected environment, (2) the temporal fluctuations of protected species within identified impact areas, and (3) the historical impact areas. In addition, the DEA does not identify lethal or sublethal levels of project-related contaminants associated with the RVs that pose an exposure risk to protected species at USAKA. This information is germane to an analysis of potential project-related impacts to significant species, especially marine mammals, sea turtles, and migratory birds.

The impact analysis in the DEA is based on population estimates of these organisms from anecdotal observations and on data collected as part of the biennial surveys of USAKA species and habitats of concern conducted by the Service and the National Marine Fisheries Service. It should be made clear that the focus of these biennial surveys is to document, in qualitative terms, the presence or absence of USAKA species of concern and to develop recommendations to conserve both species and habitats at the 11 USAKA-leased islets. The data generated by the surveys should not be interpreted as or used as a basis for an assessment of population sizes of species of concern at USAKA. Therefore, we recommend that the Final Environmental Assessment (FEA) describe these biennial surveys as being qualitative in nature, providing information on the distribution of species of concern at USAKA, but not useful for assessing population sizes of species.

Valid quantitative assessments of the population sizes of significant species that occur in the vicinity of Illeginni Islet (e.g., marine mammals, sea turtles, and migratory birds) are needed to evaluate the potential risk of RV-related impacts and, if necessary, to develop meaningful strategies to avoid or minimize individual and cumulative impacts to these species. We encourage the project sponsors to pursue development of such population assessments and recommend coordination with the National Marine Fisheries Service on future assessments of marine mammals and sea turtles in waters surrounding USAKA. Similarly, we recommend coordination with us on population assessments of nesting sea turtles and migratory birds at USAKA.

Concurrently, we encourage the project sponsors to pursue development of risk analyses on the effects of project-related hazardous materials on protected species. A goal should be to assess possible concentrations of hazardous materials that would be released into the environment from RV impacts and aerial detonations and relate these concentrations to the risk of exposure to protected species (e.g., sea turtles, migratory birds or coral reef organisms), including the identification of possible routes of exposure and uptake.

The problem of attempting to analyze potential project-related impacts based on a very limited amount of information available on critical aspects, such as the lethal and sublethal levels of exposure to various hazardous materials and the population sizes of USAKA species of concern,

was discussed early with the project sponsors. In response to this situation, the need for adequate mitigation to reduce the Proposed Action's environmental impacts to less than significant levels was strongly emphasized.

The DEA presents a good summary of the mitigation measures that would be implemented to minimize unavoidable impacts, and we support these measures (Section 4.7). However, the one measure (*i.e.*, Measure 15) intended to provide compensation for anticipated resource losses, such as the loss of sea turtle nesting habitat, falls short of providing this compensation. Although the draft FONSI states that the preservation and protection of sea turtle nesting habitat is identified "for implementation as part of the Proposed Action," the DEA states that "consideration" would be given to protecting sea turtle nesting habitat (*e.g.*, on page 91, 3rd paragraph; page 101, measure 15). We believe the measure itself is justified based on information presented in the DEA, which indicates that the Proposed Action has the potential to damage sea turtle nesting habitat at Illeginni, and on records of previous tests (*e.g.*, as recent as July 2004) that have resulted in impacts to this habitat. We believe a clear commitment to implement this mitigation measure must be included in the FEA in order to justify a FONSI.

We also recommend that the phrase "but highly unlikely" be deleted from Measure 15 in the FEA. Though not anticipated to occur more than four or five times over the next 20 years, a single RV landing on Illeginni can produce a crater approximately 15 feet deep and 25 feet across. The crater would require manual cleanup and removal of any RV debris before being backfilled with a backhoe or grader. Just one such event has the potential to essentially render viable sea turtle nesting habitat permanently unsuitable for successful nesting. Based on information presented in the DEA and on recent records of similar tests, we disagree that it is "highly unlikely" that adverse impacts to potential sea turtle nesting habitat would result from the Proposed Action.

The following comments relate to specific sections in the DEA. We offer these comments to assist in preparation of the FEA.

SPECIFIC COMMENTS

Page 20. Paragraph 1. Sentence 4: The DEA states "Targets are carefully selected to minimize the impact of RV flight tests on threatened and endangered marine mammals, sea turtles, migratory birds, and other marine life; and on the coral reef and island habitats that are protected under the UES." The DEA does not describe the criteria that will be used to "carefully select targets" in order to minimize RV-related impacts to marine mammals, sea turtles, migratory birds, marine life and coral reefs. Even with careful selection of target areas, RV impacts could unintentionally harm or destroy protected species habitat, especially for tests with targets on or near Illeginni and tests with aerial detonation near Illeginni. We recommend that a clear and detailed description of these criteria be provided in the FEA to provide a basis for understanding of how effective the proposed measures are anticipated to be and whether additional measures are needed.

Page 22. Paragraph 2. Sentence 1: The DEA states "RVs that impact in the ocean beyond shallow waters are not recovered." Since RVs contain certain hazardous materials, we

recommend the FEA include a discussion of potential adverse impacts to pelagic and deepwater benthic organisms that may occur in the vicinity of unrecovered RVs and a description of any known trophic relationships between these organisms and other species, especially those species that may be consumed by the human population at Kwajalein Atoll.

Page 23. Paragraph 3. Sentence 4: The DEA states “Just as on prior FDE flights, some of the proposed test RVs may contain varying quantities of hazardous materials including high explosives, Be, DU, and batteries.” The DEA does not describe the amounts of hazardous materials that may be contained on an RV at the time of impact at or near Illeginni Islet. We recommend that the FEA describe the amount of hazardous materials anticipated to be released and recovered at the impact sites around Illeginni and estimate the amount of unrecovered hazardous materials that may remain in the environment. We further recommend that proposed Mitigation Measure 6 lead to an evaluation of the health risk that estimated concentrations of hazardous materials, such as Be or DU, pose to protected species, such as sea turtle eggs, nesting sea turtle adults, and migratory birds, which are all commonly consumed by the Marshallese population at Kwajalein Atoll.

Page 53 Paragraph 3. Sentence 2. The DEA states “In accordance with requirements specified in the UES, USAKA must conduct a natural resource baseline survey every 2 years to identify and inventory protected or significant fish, wildlife, and habitat resources at USAKA.” The focus of these surveys is to document, in qualitative terms, the presence or absence of species of concern and to develop recommendations to conserve both species and habitat at the 11 USAKA leased islets. The data generated by the surveys should not be interpreted as an assessment of populations of species of concern at USAKA. Therefore, we recommend the FEA condition the description of the USAKA biological inventories as being qualitative in nature, providing information on the distribution of species of concern at USAKA, but not useful for assessing population sizes of species.

Page 86. Paragraph 5. Sentence 1. The DEA states “Following an aerial detonation or ocean/lagoon impact by a test RV, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind.” The DEA does not provide a clear description of the extent to which RV-related debris may impact at or near Illeginni Islet following an aerial detonation and does not fully evaluate associated potential impacts to fish and wildlife resources. Also, the DEA does not provide a clear discussion of RV-related hazardous materials that would be released into the environment following an aerial detonation and the possible routes of exposure and uptake of hazardous materials by protected species. Furthermore, the DEA does not clearly evaluate possible concentrations of hazardous materials and relate them to the risk of exposure to protected species (*e.g.*, sea turtles, migratory birds or coral reef organisms). Therefore, we recommend the FEA (1) clearly describe the potential area anticipated to be impacted by RV debris after an aerial detonation and (2) evaluate the potential impact that debris from an aerial detonation may have on protected species. We recommend that the project sponsors pursue an evaluation of the health risk that estimated concentrations of hazardous materials, such as Be or DU, pose to protected species as part of proposed Mitigation Measure 6.

Page 87. Paragraph 1. Sentence 5. The DEA states “An earlier RV test at Illeginni resulted in soil concentrations of only 5 ppm of Be in the area of highest deposition (USAF 1992).” The DEA does not relate concentrations of hazardous materials (*e.g.*, 5 ppm of Be) to the risk of exposure relative to protected species, such as sea turtle eggs or adult female green sea turtles during nest creation (*i.e.*, digging burrows) or migratory birds that occur and nest at Illeginni Islet. Therefore, we again recommend that the project sponsors pursue an evaluation of the health risk that estimated concentrations of hazardous materials, such as BE or DU, pose to protected species as part of proposed Mitigation Measure 6.

Page 88. Paragraph 4. Sentences 4, 5 and 6. The DEA states “As the results of both sets of data show, the probability for animals to be struck or exposed to the harmful affects of the underwater shock/sound waves is estimated to be no higher than 3 in one million, or 0.000003. For two or three RV simulators, to be used in a single test event, the probabilities would be 0.000006 or 0.000009, respectively. Because sea turtles generally have been shown to occur in smaller numbers, when compared to marine mammals, the result probabilities for impacts on them would be even less.” We believe it is possible that this conclusion may significantly underestimate RV landing-related negative impacts to marine mammals, sea turtles, or migratory birds that occur near or at Illeginni Islet. Population assessments of marine mammals, sea turtles, or migratory birds in the vicinity of Illeginni Islet have not been conducted, and the basis for estimating protected species populations is not clear in the DEA. It appears that these calculations may have been based on artificial population sizes extrapolated from the biennial USAKA biological inventories. If so, the basis for these probability calculations is questionable.

We encourage the project sponsors to pursue development of accurate population assessments of marine mammals, sea turtles and migratory birds within the identified RV impact area in order to more accurately evaluate probabilities of impact so that sound conclusions on the risk of the proposed action on these species is better understood. Furthermore, we recommend that analyses be conducted to evaluate the potential risk of impact that RV landings may present to protected species and that, if necessary, meaningful strategies be developed and implemented to avoid or minimize impacts to protected species.

Page 101. Measure 15. Sentence 1: The DEA states “Consideration would be given to protecting existing nesting habitat for sea turtles on Eniwetak Island (located on the eastern side of USAKA), and the reef areas immediately surrounding the island, in order to compensate for the potential, but highly unlikely, adverse impacts to sea turtle nesting sites and coral reef habitats at Illeginni.” This statement conflicts with the draft FONSI, which indicates that preservation and protection of sea turtle nesting habitat at Enewetak would be implemented, rather than merely considered. Consideration alone cannot possibly compensate for project-related resource losses, and, as mentioned previously, adequate mitigation is critical to reduce the Proposed Action’s environmental impacts to less than significant levels. Therefore, we recommend that a clear commitment to implement all of the proposed mitigation measures be included in the FEA in order to justify a FONSI. In addition, we recommend deletion of the phrase “but highly unlikely” from the above statement because the DEA and FONSI both acknowledge that impacts to Illeginni or the shallow reef adjacent to it could potentially result in the loss and degradation of some protected species habitat.


Page 90. Paragraph 3. Sentence 2. The DEA also states "Should an RV impact either an area occupied by migratory seabirds and shorebirds, any of the patches of littoral forest, or on sea turtle nesting habitat along the shoreline, birds and any other wildlife close to the point of impact could be killed, bird or sea turtle nests might be destroyed, and small areas of nesting habitat lost." In most cases, little or no information has been collected to document project-related impacts to fish and wildlife resources at Illeginni Islet. In addition, an assessment of project-related cumulative impacts to protected species populations has never been evaluated conducted. Therefore, we believe these fish and wildlife resources to be at risk from impacts anticipated to occur as a result of the Proposed Action. We conclude that compensatory mitigation in the form of preservation of fish and wildlife resources at Eniwetak Islet is warranted and we again recommend that a clear commitment to establish a protected area at Enewetak be included in the FEA in order to offset project-related impacts and justify a FONSI for the Proposed Action.

SUMMARY

As currently written, DEA is insufficient to support a FONSI for the Proposed Action. The basis for many conclusions relative to fish and wildlife impacts is not identified, referenced or included. Some conclusions are made based on inappropriate information. A commitment to provide compensatory mitigation in the form of preservation of fish and wildlife resources at Eniwetak Islet is warranted to offset anticipated project-related impacts to significant fish and wildlife resources, especially nesting sea turtles, at Illeginni Islet. We believe establishment of the proposed Enewetak Conservation Area (Mitigation Measure 15) must be implemented in order reduce the Proposed Action's anticipated environmental impacts to less than significant levels and justify a FONSI.

The Service appreciates the opportunity to comment on the DEA. We look forward to collaborating with the project sponsors in further development of the proposed mitigation measures and the establishment of the Enewetak Conservation Area at the earliest possible time. If you have any questions regarding these comments, please contact Marine Ecologist Kevin Foster by telephone (808-792-9420) or by email (kevin_b_foster@fws.gov).

Sincerely,


for Gina Shultz
Acting Field Supervisor

cc: NMFS-PIRO, Honolulu
USEPA-Region IX, San Francisco
SMDC, Hunstville
RMI-EPA, Majuro
USAKA, Kwajalein Atoll



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OGDEN AIR LOGISTICS CENTER (AFMC)
HILL AIR FORCE BASE, UTAH

17 December 2004

MEMORANDUM FOR USFWS
UNITED STATES FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS FISH AND WILDLIFE OFFICE
300 ALA MOANA BOULEVARD, ROOM 3122
HONOLULU, HAWAII 96850

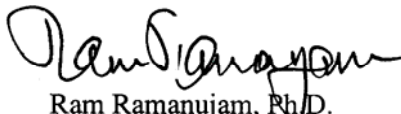
ATTN: MR. MICHAEL MOLINA

FROM: ICBM SYSTEM PROGRAM OFFICE
OO-ALC/LMV
HILL AFB UT 84056-5826

Subject: Resolution of USFWS Comments on the Draft Environmental Assessment for
Minuteman III Modification (USFWS Ref. PN-04-253).

1. In response to the referenced USFWS comments on the Draft Minuteman III Modification Environmental Assessment (EA), the United States Air Force has revised the EA to address your concerns. The most significant concerns involved the potential impacts of the proposed Minuteman III RV flight tests on the sea turtle nesting sites in the vicinity of Illeginni Island at Kwajalein Atoll, the Republic of Marshall Islands which were the subject of telecons between Mr. Randy Gallien, US Army Space and Missile Defense Command, Huntsville, AL, and your office. Revisions were made to pages 20, 53, 87-89, and 101-102 of the EA pursuant to the agreements reached between you and Mr. Gallien. The yellow highlighted sections in the enclosed documents clearly show the revisions agreed upon by USASMDC, ICBM SPO, AFSPC, DOE/LLNL and SMC/AXF. The USAF has already incorporated those revisions in the final EA, which will be provided under separate cover at the same time that it is transmitted to SAF/AQR for FONSI approval.

2. I appreciate your responsiveness in providing the comments on the draft EA in a timely manner, and for your assistance in resolving the comments. It has been my pleasure and privilege to work with you on a number of difficult issues, and reach amicable resolutions on those issues in a very timely and expedient manner. I am especially pleased how we were able to bring together such a diverse group of professionals to the Consultation Meeting with your group, and work on the various truly difficult issues and achieve mutually satisfactory resolutions. I look forward to working with you and your group on issues relevant to the DEP process and activities toward speedy resolutions. Please feel free to contact me at 801-777-2846 (DSN: 777-2846) or via email should you have any questions relevant to the EA and DEP. Thank you very much.


Ram Ramanujam, Ph.D.
Aerospace Engineer

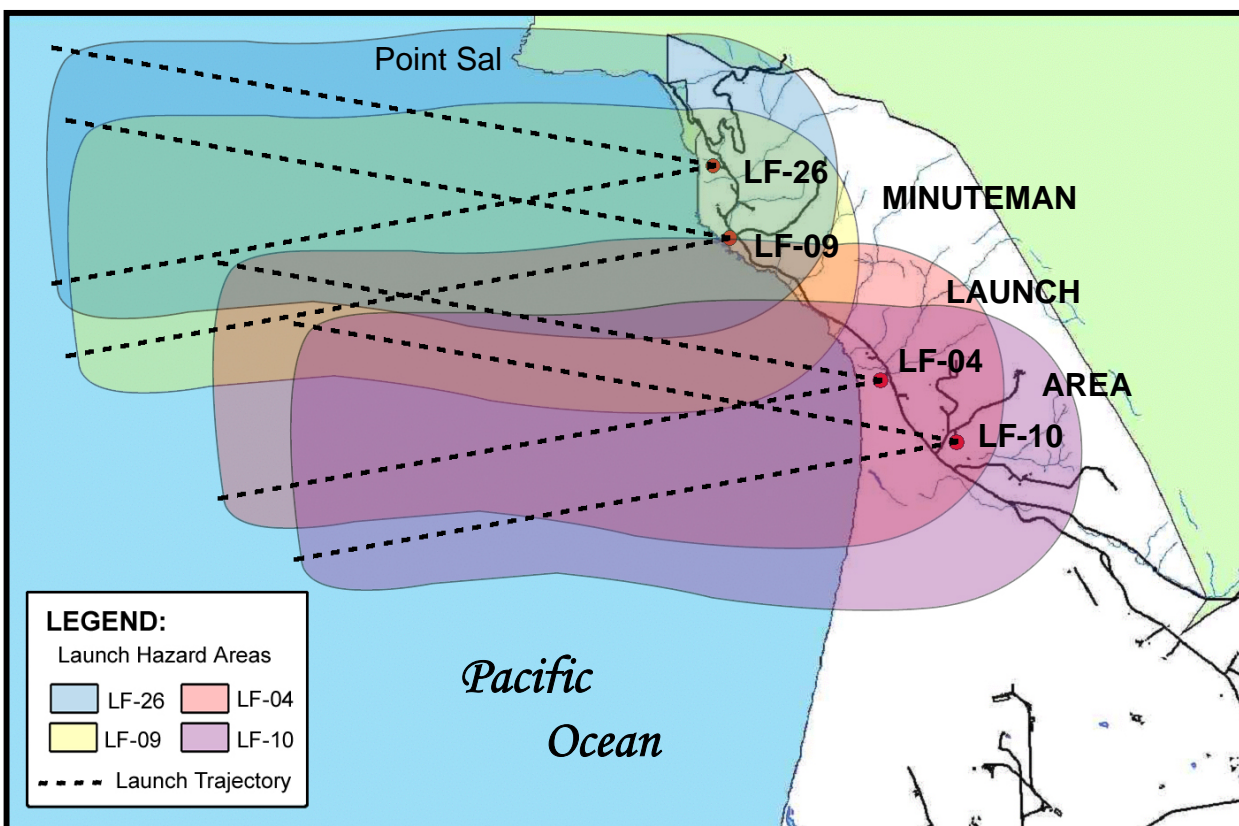


Figure 2-11. Range of Minuteman III Launch Trajectories and Launch Hazard Areas at Vandenberg AFB, California

2.2.4 US Army Kwajalein Atoll

Towards the terminal end of each MM III FDE flight, beyond the 3rd-stage motor drop zone, the post-boost vehicle fragments impact in a predetermined area of the ocean northeast of USAKA in the RMI. The hazard areas for missile impact are shown in Figure 2-12 for a representative MM III flight path. Traveling slightly farther, the one to three RVs (per flight) are targeted towards designated deep ocean areas east of the Kwajalein reef, or in the vicinity of Illeginni Island, depending on mission requirements. Targets are carefully selected to minimize the impact of RV flight tests on threatened and endangered marine mammals, sea turtles, migratory birds, and other marine life; and on the coral reef and island habitats. In particular, areas designated as habitat for species of concern, under the UES, would not be targeted.

To ensure the safe conduct of these types of tests, a Mid-Atoll Corridor Impact Area has been established across USAKA, as is shown in Figure 2-12. When a point of impact is to occur in this area, a number of strict precautions are taken to protect personnel. Such precautions may consist of evacuating nonessential personnel and sheltering all other personnel remaining within the Mid-Atoll Corridor. Just as at Vandenberg AFB, NOTAMs and NOTMARs are published and circulated in accordance with established procedures to provide warning to personnel, including natives of the Marshall Islands, concerning any potential hazard areas that should be avoided. Radar and visual sweeps of hazard areas are accomplished

The Mid-Atoll Corridor straddles Kwajalein Atoll, which is a crescent-shaped coral reef dotted with a string of approximately 100 islands that enclose the world's largest lagoon [1,100 square mi (2,849 square km)]. Lagoon depths are typically 120 to 180 ft (37 to 55 m), although numerous coral heads approach or break the surface. Ocean depths outside the lagoon descend rapidly, to depths as much as 13,000 ft (3,952 m) within 5 mi (8 km) of the atoll. The top of the Kwajalein Atoll reef (or reef flat) is intertidal. Natural passages through the reef flat allow passage of marine mammals, sea turtles, and other marine life to and from the lagoon.

Both the reef rock from which the atoll is built, and the sands and sediments of its beaches and lagoon bottom, are formed entirely from the remains of calcium-secreting marine organisms such as coral, coralline algae, calcareous algae, mollusks, and foraminiferans. The tops of the reefs are a thin veneer of actively growing organisms that accrete over the remains of prior generations of reef organisms and add to the reef structure. The reef-building organisms are sensitive to sedimentation, burial, and changes in circulation caused by human activities.

The descriptions of biological resources provided in the paragraphs that follow are based largely on past surveys conducted by the USFWS and NMFS. In accordance with requirements specified in the UES, USAKA must conduct a natural resource baseline survey every 2 years to identify and inventory protected or significant fish, wildlife, and habitat resources at USAKA (USASMDC, 2003a). In providing support to USAKA, USFWS and NMFS personnel normally conduct the biennial biological resource inventories at all islets leased from the RMI, which includes those areas on and adjacent to Illeginni Island. These surveys were initiated in 1996 and continue to be conducted on a regular basis every 2 years. The next survey is scheduled to occur in 2004. It is important to note that the USAKA survey data is qualitative in nature, so data gathered at other geographical locations [i.e., Pacific Missile Range Facility (PMRF), Hawaii], with known species densities, were used to determine risks to marine mammals in Chapter 4. Although the population sizes of marine mammals in the vicinity of Illeginni are not known, the surrogate data used in the analysis is considered to be conservative since marine mammal densities at Kwajalein are not expected to exceed densities in areas of Hawaii where marine mammals have been documented for many years. For sea turtles, however, no comparable data existed so we evaluated the probability for habitat destruction since habitat details are known.

Vegetation

Illeginni is a 31-acre (12.5-hectare) island consisting of managed vegetation (primarily grassy lawns) surrounding buildings and other facilities, and four relatively large patches of native vegetation (see Figure 3-3). The native vegetation present on the island consists of one patch of herbaceous strand and several patches of littoral (near shore) forest. The forest areas are made up primarily of *Pisonia*, *Intsia*, *Tournefortia*, and *Guettarda* trees. Some littoral shrubland can also be found mostly on the western end of the island. (USFWS/NMFS, 2002)

Threatened, Endangered, and Other Protected Species

Within the area of Kwajalein Atoll, the UES provides protection for all of the following:

- Any threatened or endangered species that may be present
- Any species proposed for designation, candidates for designation, or petitioned for designation to the endangered species list that could be affected by USAKA activities

Potential ecological effects on Illeginni Island can be assessed on the basis of deposition and concentration patterns observed from prior RV tests on land. Debris and ejecta occur close to the point of impact, mostly within a 328-ft (100-m) radius. It is expected that very little of the RV battery materials would survive impact. For the DU and Be, the deposition of small particles can contribute to elevated levels in soil in the immediate vicinity of the impact point and extend downwind. An earlier RV test at Illeginni resulted in soil concentrations of only 5 ppm of Be in the area of highest deposition (USAF, 1992a). For comparison purposes, this concentration falls in the low end of the range of naturally occurring Be found in soils in the United States, which ranges from 0.1 to 40 ppm (ANL/DOE, 2002). The Be remains bound to the soil within the environmental pH range of 4 to 8 and does not dissolve in water, thus preventing release to ground water (USEPA, 1998). Furthermore, Be is not likely to be found in natural water (within normal pH ranges) in greater than trace amounts, because of the extreme insolubility of the material (NAS-NRC, 1977).

For the DU particles deposited on the ground, studies have shown that low levels of soluble U will travel very slowly through soil and are subject to adsorption as they pass through the soil (DOD, undated; Stegnar and Benedik, 2001). The transport of U with rainwater runoff is limited because of its low solubility and high density (DOD, undated). Even under extreme hydraulic conditions within a laboratory, the probability for significant surface water transport of DU from soil appears to be low (WRRC, 1995). Possible DU contamination of ground water from vertical migration has also been shown to be highly unlikely (DOD, undated).

The concentrations of soluble Be in soil will be orders of magnitude below the observed phytotoxicity concentration of 2 ppm soluble Be (USAF, 1992a). Plants also do not readily absorb U from soil (Stegnar and Benedik, 2001). In view of the very low solubility and limited transport of Be and DU in soil and water, it is not likely that these materials would have any serious adverse effects on plants at Illeginni, or on the animals that might feed on those plants. Though there is the potential for migratory birds on the island to breathe respirable dust particles of Be and DU, or consume particles deposited on vegetation, exposures (through breathing or feeding) to significant levels of these materials are not expected because of the small amount of unrecovered material that may persist in the environment.

Beyond 164 ft (50 m) from the impact crater, under probable meteorological conditions, there is deposition on the water surface. The process of mixing Be and DU particles by tide and surf would rapidly dilute the small amounts deposited, and considering the low solubility of the Be and DU, resulting concentrations would be low and non-toxic to fish, sea turtles, coral, and other marine invertebrates along the reef. Eventually, the Be and DU are deposited as sediment, where they would slowly weather just as they do in the soil (USAF, 1992a). Thus, the overall health of the coral reef should not be affected.

Based on existing data, definitive conclusions on risks to animal species and human health cannot be reached. For this reason, soil, sediment, and tissue samples have been taken at Illeginni Islet, and along the shorelines and shallow marine environments of the lagoon and ocean side of the islet. Though the sampling effort at Illeginni has already been completed, the analytical results for the samples collected are not expected until late 2004. Once the sampling results are known, the information will be utilized in determining the need for further investigation in consultation with the USFWS, NMFS, USEPA, and RMIEPA, and if additional mitigation measures are warranted.

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

test RV contains a high explosives package makes little difference. The resulting underwater waveform in either case would last only about 10 to 30 milliseconds. (Moody, 2004a; Tooley, et al., 2004)

As described earlier, the onset of TTS in marine mammals has been determined to occur at peak pressure levels of about 218 to 224 dB (referenced to 1 micropascal and equal to 12 to 23 psi, respectively), depending on the species and only for occasional, short-term exposures. Based on the underwater acoustic impulse produced by an RV impact, distances for when the onset of TTS might occur in marine mammals are presented in Table 4-5. As the table shows, this distance ranges from 62 to 128 ft (19 to 39 m), depending on which sound pressure level is used. For this analysis, it is presumed that sea turtles would also fall within this range for TTS occurrence.

| Table 4-5. Reentry Vehicle Impact Distances for the Onset of Temporary Threshold Shift (TTS) in Marine Mammals | | | |
|---|--|--|---|
| Sound Pressure Level (dB ref to 1 micropascal) | Equivalent Underwater Peak Pressure (psi) | Radial Distance from the Point of RV Impact ¹ [ft (m)] | Reference for Pressure Level |
| 218 | 12 | 128 (39) | 69 FR 2333-2336 69 FR 29693-29696 Ketten (1995) |
| 224 | 23 | 62 (19) | Finneran, et al. (2002) |

Notes:

¹ Radial distances were calculated in accordance with methods described in Moody (2004a).

At distances less than 62 ft (19 m) from the RV impact point, it can be expected that marine mammals and sea turtles might suffer PTS and/or other injuries. An underwater pressure level of approximately 240 dB (referenced to 1 micropascal and equal to 145 psi) is considered the baseline criterion for defining physical injury or death for marine mammals (Ketten, 1998). Such pressure levels would only occur within several feet of the RV impact point. With increasing distance from the RV impact point, pressure levels would decrease, as would the risk for injury to animals. The range of impact distances for the onset of TTS, and for determining physical injury/death, are illustrated in Figure 4-2. Because the 218-dB (referenced to 1 micropascal) level represents the lowest pressure level for when TTS might occur, it can be considered the outermost limit for potential harm to marine mammals, as well as for sea turtles.

Because the USAKA survey data described in Section 3.5.1 is qualitative in nature, probabilities for determining potential underwater shock/sound wave impacts on protected marine mammals were based on surrogate data from the sea range at PMRF, Hawaii, which has higher species densities than the Illeginni Island vicinity. Using the sound pressure levels identified earlier in Table 4-5, probabilities for the number of groups (pods or schools) of marine mammals that could potentially be impacted by a single RV are presented in Table 4-6 for the onset of TTS, and for physical injury/death. As the results show, the probability for animals to be struck or exposed to the harmful affects of the underwater shock/sound waves is estimated to be no higher than 3 in one million, or 0.000003. For two or three RV simulators to be used in a single test event, the probabilities would be 0.000006 or 0.000009, respectively. Because sea turtles generally have been shown to occur in smaller numbers, when compared to marine mammals, the resulting probabilities for impacts on them would be even less.

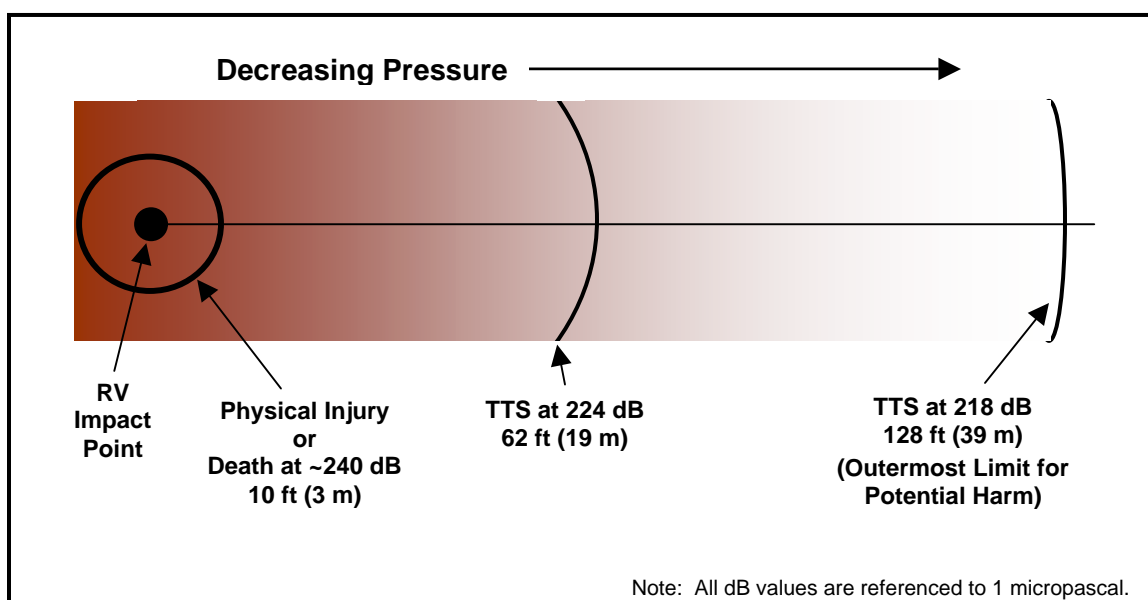


Figure 4-2. Illustration of Predicted Ranges for Underwater Shock/Sound Wave Impacts on Marine Mammals

| Table 4-6. Number of Groups¹ of Marine Mammals that May Experience Temporary Threshold Shift (TTS), or Suffer Physical Injury or Death, from a Reentry Vehicle Impact | | | | |
|---|---|---|---|----------|
| Sound Pressure Level (SPL) (dB ref to 1 micropascal) | Radial Distance from the Point of RV Disintegration [ft (m)] | Potential Effect | Number of Groups of Marine Mammals Exposed² | |
| | | | | |
| 218 | 128 (39) | TTS [original limit by Ketten (1995)] | | 3.01E-06 |
| 224 | 62 (19) | TTS [new limit by Finneran, et al. (2002)] | | 4.52E-07 |
| 240 | 10 (3) | Physical Injury or Death | | 2.19E-07 |

Notes:

¹ Marine mammals occur in groups (pods or schools), and aerial and shipboard sightings of marine mammals are reported in units of groups rather than of individuals. Hence, group density rather than the density of individuals is the appropriate basis for estimating the risk of RV impacts to marine mammals. For analysis purposes, a single group is assumed to contain 10 to 12 animals.

² Estimations of TTS, physical injury, and death impacts are fully described in Ramanujam (2004).

- 5) Minimize helicopter and vehicular traffic in the vicinity of a land impact crater until the soil deposition is stabilized by wetting, and the helipad has been washed or swept down (Section 4.5.3).
- 6) Conduct sampling of the air and soil to ensure that the concentration in air of Be and of DU does not exceed established standards. Removal of the top 0 to 2 inches (0 to 5 cm) of soil would be required if concentrations exceeded established standards. (Sections 4.5.3 and 4.5.4)
- 7) Maintain necessary surveillance of the cumulative effect from repetitive tests to ensure that the criteria listed in item (6) are maintained (Section 4.5.4).
- 8) Maintain records of Be and DU concentrations in air and soil to document the tests results, and transmit them to the USAKA Environmental Management Office within 6 weeks from the date of sampling (Section 4.5.4).
- 9) Avoid unnecessary disturbance of migratory bird nests (Section 4.5.1). (See also measure 14.)
- 10) Refill any land crater in a manner that is least damaging to the environment (Section 4.5.1), with precautions taken to avoid exposure of personnel to any hazardous levels of Be and DU (Section 4.5.3).
- 11) Should an RV impact within one of the littoral forest areas on Illeginni or elsewhere in the vicinity, the least possible amount of vegetation and habitat would be disrupted for equipment access and cleanup operations (Section 4.5.1). (See also measure 14.)
- 12) Perform opportunistic marine mammal monitoring in the vicinity of the Illeginni Island from the helicopter flights to and from the island during the days and weeks leading up to a scheduled MM III flight test, and report the results to the USAKA Environmental Management Office, RTS Test Group, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list, and for consideration in approving the launch. (Section 4.5.1).

Group 2—USAKA Environmental Management Office

- 13) Develop protocols or best management practices in consultation with the appropriate agencies to determine which craters should be filled and which should be left unfilled to avoid further impacts or disturbances to the reef, following RV impacts on the reef. Any such movement of equipment would occur along predetermined routes to minimize environmental effects. (Section 4.5.1)
- 14) Develop protocols or best management practices in consultation with the appropriate agencies for the cleanup and backfilling of craters in littoral forests, or in other valuable habitats, by incorporating methods and procedures that would avoid and/or minimize additional impacts to such resources during the cleanup activities. (Section 4.5.1)
- 15) USAKA, in cooperation with the RMIEPA, will establish a protected area for existing sea turtle nesting habitat on Eniwetak Island (located on the eastern side of USAKA), and the reef areas immediately surrounding the island, in order to compensate for potential impacts to sea turtle nesting and coral reef habitats at Illeginni. Eniwetak was selected on the basis of (a) the presence of active turtle nesting sites, and (b) the availability of viable enforcement options to protect the sea turtles and their nesting sites from poachers. (Section 4.5.1) The details of the protected area to be established will be defined through the DEP process.
- 16) USAKA will transmit the records of Be and DU concentrations in air and soil to the RMI Government within two weeks from the date of receipt of such records from DOE/LLNL through the established channels approved by the US State Department. (Section 4.5.4)
- 17) Based on existing data, definitive conclusions on risks to animal species and human health cannot be reached. For this reason, soil, sediment, and tissue samples have been taken at Illeginni Islet, and along the shorelines and shallow marine environments of the lagoon and ocean side of the islet. Though the sampling effort at Illeginni has already been completed, the analytical results for the samples collected are not expected until late 2004. Once the sampling results are known, the information will be utilized in determining the need for further investigation in consultation with the USFWS, NMFS, USEPA, and RMIEPA, and if additional mitigation measures are warranted. Based

on sample analyses, and other new information as it becomes available, strong consideration will be given to further investigation of associated risks.

APPENDIX D

***BIOLOGICAL OPINION ON THE EFFECTS OF THE
MINUTEMAN III MODIFICATION ON
NESTING HABITAT FOR THE GREEN TURTLE
(CHELONIA MYDAS)***



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850



In Reply Refer To:
PN-04-246

JAN 11 2005

Colonel Jeffrey C. Smith
U.S. Army, Deputy Chief of Staff, Engineer
U.S. Army Space and Missile Defense Command
P.O. Box 1500
Huntsville, Alabama 35807-3801

Dear Colonel Smith:

Subject: Biological Opinion on the Effects of the Minuteman III Modification on Nesting Habitat for the Green turtle (*Chelonia mydas*).

Dear Colonel Smith:

This responds to your September 15, 2004, request for consultation under section 3-4.5.3 (Procedures for Consultation on Endangered Resources) of the U.S. Army at Kwajalein Atoll (USAKA) Environmental Standards (UES) (8th edition) for the proposed Draft Environmental Assessment (DEA) Minuteman III Modifications (MMII), August 24, 2004. The U.S. Air Force (USAF) is the action agency for this project and is proposing to modify MMIII flight tests in which the re-entry vehicle (RV) portion of the MMIII missile terminates in either the Pacific Ocean (Kwajalein Bight), the shallow marine environment near Illeginni Islet, or on Illeginni Islet, a USAKA-controlled area at Kwajalein Atoll, Republic of the Marshall Islands (RMI). The proposed project is to increase the number of flight tests from 3 or 4 per year by two additional flight tests in fiscal years 2005 and 2006; and beginning in 2006, Mark 12 RVs would be replaced with Mark 21 RVs. This document represents the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) on the effects of the proposed project on the green turtle (*Chelonia mydas*), a federally listed threatened species under the U.S. Endangered Species Act (Act), and USAKA Species of Concern for which consultation is triggered under the UES (section 3-4.5.3).

This BO is based on the following information: 1) the USAF August 24, 2004 DEA; 2) biological literature (see Literature Cited section at the end of the document); and 3) other information sources. Our log number for this consultation is PN-04-246. Copies of pertinent materials and documentation are maintained in an administrative record in our Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii.

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Consultation History

- August 24, 2004: The USAF released the DEA to the public on August 24, 2004. The DEA serves as the Notice of Proposed Action (NPA) for a Document of Environmental Protection (DEP) and the Biological Assessment (BA) for species consultation under the UES.
- September 15, 2004: The Space and Missile Defense Command initiates consultation under the UES based on its determination that the proposed MMIII project may adversely affect green turtle (*Chelonia mydas*) nesting habitat at Illeginni Islet, Kwajalein Atoll, Republic of the Marshall Islands.

BIOLOGICAL OPINION

Description of the Proposed Action

This project description summarizes information taken from the August 2004 DEA. The proposed action is a modification of an existing program in which MMIII missiles launched from Vandenberg Air Force Base, California, cross the central North Pacific, and impact within the Mid-Atoll Corridor Impact Area, USAKA, Republic of the Marshall Islands. This area includes a broad area of the mid-section of Kwajalein Atoll. The intent of the flight test is to target either Illeginni Islet, the vicinity of Illeginni Islet or the deep ocean locations, east and west of Kwajalein Atoll. Most RVs targeted for the vicinity of Illeginni will impact in the deep ocean area south of Illeginni. A small number of RV flights are anticipated to impact at Illeginni Islet and or on the reef flats within its vicinity over the life of the program. The action proposes to modify the existing MMIII program with: new hardware for the Mark 21 RV; new electronic signal generators; changes to software programs and data collection systems; modifications to system test and evaluation hardware/software; personnel training; and an evaluation of the modified MMIII missile flight test.

Under normal circumstances, approximately three or four MMIII test flights are conducted each year. Four additional flight tests may be conducted in 2005 and 2006, with two tests scheduled between June and August, 2005, and two tests scheduled between February and September, 2006. RVs may contain quantities of hazardous materials that include high explosives, Beryllium (Be), Depleted Uranium (DU), and batteries. Only one RV per year is planned to contain high explosives, and would be targeted for the vicinity of Illeginni Island. A small number of RV flights are anticipated to impact at Illeginni Islet or on the reef flats of Illeginni Islet over the life of the program. RVs that impact on Illeginni Islet, or in the shallow nearshore marine environment near Illeginni, will form a crater. Sediments are displaced by the RV and ejected, along with RV debris, up to 100 meters (m) from the crater. In addition, RVs may be aerially detonated between several hundred and several thousand feet above Illeginni Islet, resulting in the dispersion of particles and fragments at the impact site, and within its vicinity over an undescribed area.

Debris is recovered when RVs impact on Illeginni Islet, or in the shallow marine environment, within approximately 152 to 305 m from the shoreline, or when RVs impact in the ocean at depths less than 30 m. RVs that impact in the ocean at depths greater than 30 m are not recovered.

Debris is excavated from impact sites with the use of a backhoe. Excavated material is screened and RV debris is recovered. RV impact holes are back-filled with displaced coralline algae, mollusc sediments, rubble and rocks. The DEA indicates that some RV debris (small fragments millimeters in size) will never be recovered from the environment.

Conservation Measures

The following list of activities represent actions that USAKA and the USAF will undertake to avoid or minimize impacts to green turtle nesting habitat at Illeginni Islet. These activities will be undertaken as part of the process to develop a Document of Environmental Protection (DEP) for the MMIII project. The Service believes implementation of these actions will result in significant steps towards offsetting sea turtle nesting habitat losses at Illeginni Islet.

- 1.a. USAKA, in coordination with the USAF, RMI and USFWS, will support establishment of a sea turtle nesting preserve at Eniwetak Islet as part of the DEP process for the MMIII project in accordance with the associated timelines identified in the most recent edition of the UES.
- 1.b. USAKA will initiate consultation with the RMI to establish protocols to ensure that unauthorized personnel will not have access to Eniwetak. The protocols will address such issues as periodic inspections, removal of trespassers, sanctions for violation of access restrictions and public awareness activities. Public awareness activities may include public meetings, advertisements (newspaper and radio), or other media and signage at Eniwetak.
- 1.c. USAKA will monitor beaches at Eniwetak Islet for sea turtle nesting success. Inspections for sea turtle nests, egg incubation and hatchling success will be made on a monthly basis during peak nesting periods (May – November).
- 1.d. USAKA will maintain nesting beaches at Eniwetak Islet by removing marine debris or other hazards that may impede female haul-out, nesting, egg incubation, and hatchling migration to the ocean.
- 1.e. USAKA, USAF and Department of Energy/Lawrence Livermore National Laboratories (DOE/LLNL) will inspect beach areas for active nests at Illeginni, beginning 70 days prior to each RV impact. If eggs are discovered, they will be moved to Eniwetak Islet, in coordination with the USFWS and USAKA Environmental Office. Protocols for relocating eggs from nests at Illeginni to nests at Eniwetak will be provided by the USFWS to USAKA upon request.

Status of the Species/Critical Habitat

Information in this section is taken from the *Recovery Plan for U.S. Pacific Populations of the Green Turtle* (NMFS and USFWS, 1998), unless otherwise noted.

Species Description

The green turtle (*Chelonia mydas*) is the largest member of the marine turtle family CHELONIIDAE and is found throughout the Pacific, Indian, and Atlantic oceans and the Mediterranean Sea. Green turtles are distinguished from other sea turtles by their smooth carapace with four pairs of lateral scutes, a single pair of prefrontal scutes, and a lower jaw-edge that is coarsely serrated. Adult green turtles may weigh more than 100 kilograms (kg) and exceed one meter in carapace length. The common name of this species refers to the green color of its subdermal fat. The carapace color of adult turtles ranges from light to dark brown, sometimes with an olive cast, radiating or wavy lines, and/or dark blotches. The plastron typically is yellowish to orange, and in the east Pacific often has a grayish cast.

The major taxonomic split within this species is between populations in the Atlantic/Mediterranean and populations in the Pacific/Indian oceans. Although the populations of green turtle in the East Pacific have traditionally been referred to as a distinct subspecies (*C. mydas agassizii*), this distinction as yet has no documented genetic basis. Nevertheless, mitochondrial DNA studies have revealed fixed or near-fixed genotypic differences among nesting populations. This genetic substructure underlies the natal-beach homing behavior of reproductive female turtles. For management and conservation purposes, each nesting population must be treated as an independent demographic unit.

The green turtle was listed in 1978 as threatened under the Endangered Species Act (Act) throughout its Pacific range because of overexploitation, habitat loss, lack of regulation and adequate enforcement, and evidence of declining numbers. Populations nesting in Florida and on the Pacific coast of Mexico are classified as endangered under the Act. The green turtle is also classified as endangered worldwide by the International Union for the Conservation of Nature and Natural Resources, and it is listed in Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Because of its status as a federally and internationally protected species, green turtles were included among other sensitive animals afforded special protection at USAKA under the UES in 1995. In 1998, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service completed a recovery plan for the U.S. Pacific populations of the species.

Life history

Throughout their range, adult green turtles typically are resident in foraging areas (e.g. seagrass or macro-algae habitats). Periodically, turtles migrate long distances to breeding areas where copulation and nesting take place. Mating usually terminates when nesting has commenced. Based on growth rates observed in wild green turtles, females are thought to reach sexual maturity at 25 years of age or later (Eckert, 1993). Reproductive females generally nest every year, but may skip years. Adult males may migrate and breed every year. Females emerge from the sea to nest 25-35 days after copulation. Green turtles may lay up to six clutches in one season, and each clutch may contain about 100 eggs. After the female has laid the eggs and covered them, the eggs incubate in the soil for up to two months (mean = 64.5 days Balazs 1980). Hatchlings are photopositive and may be disoriented from their search for the sea by artificial light.

Green turtles prefer areas where surface water temperatures are no lower than about 20° centigrade (C) in the coldest month; for example, during warm spells (e.g., El Niño), green turtles may be found considerably north of their normal distribution. Based on the behavior of

post-hatchlings and juveniles raised in captivity, it is presumed that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (NMFS and USFWS, 1998). The maximum recorded dive depth for an adult green turtle was 110 meters (NMFS and USFWS, 1998), while subadults routinely dive 20 meters for 9-23 minutes, with a maximum recorded dive of 66 minutes (NMFS and USFWS, 1998). Additionally, it is presumed that drift lines or surface current convergences are preferential zones due to increased densities of likely food items. In the western Atlantic, drift lines commonly contain floating *Sargassum* capable of providing small turtles with shelter and sufficient buoyancy to raft upon (NMFS and USFWS, 1998).

Sea turtle gender is primarily determined by nest temperature (Mrosovsky and Yntema 1980; Yntema and Mrosovsky 1980; and Morreale et al., 1982). Clutches produced between 27°C and 31°C are usually mixed gender. Eggs incubated when average temperatures fall below 27°C during the middle trimester produce males, while females are usually produced when temperatures exceed 31°C (Alvarado and Figueroa, 1987).

Most green turtles appear to have a nearly exclusive herbivorous diet, consisting primarily of sea grass and algae (Wetherall *et al.*, 1993). In some areas, such as along the eastern Pacific coast, green turtles display carnivory, feeding on molluscs and polychaetes, fish, fish eggs, and jellyfish. In the Hawaiian Islands, green turtles are site specific, feeding consistently in the same areas on preferred substrates, which vary by location and between islands (NMFS and USFWS, 1998).

Population Dynamics

The absolute number of green turtles in any population is difficult to assess. The size of a population typically can only be measured as the relative abundance of nesting females. Because an individual female may only nest once every two or more years, even these measures are very rough estimates.

Historical and recent accelerated rates of exploitation of green turtles have lead to significant declines in their distribution and resulted in fewer and smaller remaining breeding sites. In the western Pacific, the only major (greater than 2,000 nesting females) populations of green turtles occur in Australia and Malaysia. Smaller colonies occur in the insular Pacific islands of Polynesia, Micronesia, and Melanesia (Wetherall *et al.*, 1993) and at French Frigate Shoals (FFS) and scattered locations in the Hawaiian Archipelago (Balazs, 1995). In the Marshall Islands, Bikar Atoll may support between 100 and 500 nesting females (Puleloa and Kilma, 1992), and between 25 and 100 nests may occur at Erikub, Jemo and possibly Ailinginae Atolls (Puleloa and Kilma, 1992). Other atolls may support low level nesting (less than 25 nests) activities, but little information is available concerning current breeding success in these areas.

Although attempts have been made to model the population dynamics of green turtles, few data are available that describe key life history traits, such as growth rates, recruitment, and mortality

that influence the population variability and stability of this species (Chaloupka and Musick 1997).

Status and Distribution

Green turtles are declining throughout the Pacific Ocean as a direct consequence of overexploitation and habitat loss (Eckert, 1993). Recovery efforts are hampered by the lack of information about the numbers, distribution, and migration patterns of turtles in most U.S. Pacific populations. Although quantitative assessment of declines also is limited, the continuing decline in this species is the result primarily of harvesting of eggs and adults by humans and nesting habitat due to human development-related activities. Furthermore, nesting sites will not be replenished by the recruitment of turtles from other nesting sites because of the species high fidelity to natal beaches. In the green turtle recovery plan, this directed take is identified as a "major problem" throughout U.S. Pacific territories and the Freely Associated States (FAS: *i.e.*, Republic of the Marshall Islands, Federated States of Micronesia and the Republic of Palau). Severe exploitation of turtles and their eggs in recent decades throughout their range reflects important socio-cultural and economic changes in the Pacific (and throughout the green turtle's range). Specifically, these changes include: 1) erosion of traditional restrictions limiting the number of turtles taken by increased use of island residents; 2) modernized hunting gear; 3) easier boat access to remote islands; 4) extensive commercial exploitation for turtle products in both domestic markets and international trade; and 5) loss of the spiritual/cultural significance of turtles.

Continued poaching, incidental take by sport and commercial fishing gear, and the incidence and severity of tumors caused by a fibropapilloma disease in Hawaii, all act to compromise the green turtle's recovery. Fibropapilloma is often fatal and its etiology is unknown.

Environmental Baseline

The environmental baseline describes the status of the species and factors affecting the environment of the species or critical habitat in the proposed action area contemporaneous with the consultation in process. In this case, the baseline includes RMI, local, and private actions that affect the species at the time the consultation begins. Unrelated Federal actions that have already undergone consultation are also a part of the environmental baseline. Federal actions within the action area that may benefit listed species or critical habitat are also included in the environmental baseline.

Status of species within the action area

In the Marshall Islands, sea turtle nesting generally occurs between May and November, with some exceptions of nesting observed in December. At Illeginni Islet, the western shoreline (inter-islet reef flat) and northwestern shoreline (lagoon facing) are suitable nesting locations for green turtles (USFWS and NMFS, 2000). Three nest pits were observed at the western shoreline by Service and NMFS biologists in 1996 (USFWS and NMFS, 1996).

Factors affecting species environment within the action area

Few data are available with which to assess population dynamics for this or any sea turtle species. The Marshall Islands population of green turtles is at risk from human harvest of adults, juveniles and eggs; incidental take by fishing gear; marine debris; egg and hatchling predation by rats; and loss of nesting habitat due to human encroachment and construction in areas previously

used by sea turtles (McCoy, 2004). The vast majority of green turtles nesting in the Marshall Islands may be highly sensitive to any perturbations that take place at existing nesting sites.

Existing activities that affect green turtles at Illeginni Islet include: 1) RV's have been documented to impact and contaminate sea turtle nesting habitat at Illeginni Islet; 2) general USAKA operations (e.g., maintenance of existing infrastructure, refurbishment activities and heli-pad) which may interrupt attempts by female green turtles to haul-out and nest on the islet; 3) release of hazardous materials during the detonation of unexploded ordnance at the designated ordnance burn site (western end of islet) which may disturb egg incubation, sea turtle haul-out, or hatchling migration to the ocean; 4) the harvest of green turtle eggs, juveniles and adults by humans for subsistence purposes; and 5) egg and hatchling predation by rats (*Rattus* sp).

Effects of the Action

Turtle nesting habitat may be destroyed when an RV impacts at Illeginni or during post-impact cleanup-related activities (USAF, 2004). In the event an RV impacts on or heavy equipment traverses across turtle nesting habitat, it is possible that turtle eggs may be severely damaged or destroyed, and that the suitability of the habitat for future successful nesting may be eliminated by associated physical changes to that habitat.

The overall effect of the action would not benefit green turtles and other wildlife on Illeginni Islet. RV impacts and recovery activities are expected to result in degradation to shoreline areas that support such habitat, affecting the ability of sea turtle nesting activities to stabilize. Without the action, it is feasible that sea turtle nesting may stabilize, particularly if other negative influences could be eliminated or controlled in concert.

Prior to each launch that could potentially impact at or near Illeginni Islet, USAKA will inspect sea turtle nesting habitat to ensure that no sea turtles are hauled out or active nests exist that could be affected by the RV. The USAF has projected that approximately four or five RVs will impact at Illeginni over the next twenty years. It is also feasible that RV-generated sediment plumes that impact near Illeginni may negatively affect sea turtle nesting habitat as well. However, the window of time that an adult green turtle would be exposed on Illeginni to risk of harm from the RV impact is considered quite small and the risk to be negligible.

The proposed action may, however, result in take in the form of harm or harassment of green turtles by precluding females from haul-out and nesting, preventing normal embryonic development, disturbing or destroying turtle nests, and compromising hatchling growth and success. In addition, a single RV landing on Illeginni can produce a crater approximately 15 feet deep and 25 feet across and eject sediments (e.g, primarily coral rubble) up to 100 m from the crater across the islet. Just one such event has the potential to essentially render viable sea turtle

nesting habitat permanently unsuitable for successful nesting, and injure or kill hatchlings at Illeginni Islet.

Three sea turtle nests at Illeginni Islet were observed by the Service during the USAKA biennial survey in 1996. Though the nests were not disturbed, we anticipate that each clutch may contain about 100 eggs (Balazs 1980), or about 300 eggs total at the nesting site. Potential project-related impacts to eggs include direct impacts from RV's, post-impact refurbishment activities (e.g., earth moving equipment), or from exposure to project-related contaminants.

Certain components of the RV are comprised of Depleted Uranium (DU), a heavy metal, and Beryllium (Be). When an RV impacts on Illeginni Islet or the shallow nearshore marine environment, it breaks up. As heavy metals mix into the Illeginni environment, they may present an exposure risk, primarily to animals. Exposure to toxic levels of heavy metals has been documented in test animals to result in growth anomalies, tumors, pneumonitis, hypersensitivity, cancer and death (T.C. Pellmar *et al.*, 1999; Hoffman *et al.*, 2003; Klaassen *et al.*, 1986; and Lewis 1998).

Soil sampling for Be was conducted at an RV impact site in 1992 that resulted in the identification of Be concentrations of about 5 parts per million, very near background levels. Though Be and DU are known to be highly insoluble (USAF, 2004), sea turtles have not been evaluated for toxic exposure to DU or BE, and it is feasible that the health of nesting females, embryos, and hatchlings at Illeginni may be degraded, resulting in reduced ability of the animal to resist diseases, successfully evade predators, forage or reproduce.

The USFWS and NMFS have recently collected tissue samples of organisms in the vicinity of Illeginni Islet. The samples are being currently analyzed at the Lawrence Livermore National Laboratories (LLNL). Evaluation of these samples is the beginning of a process to determine the potential for toxic exposure of DU and BE to sea turtles.

Establishing Eniwetak Islet as a conservation area would protect the existing sea turtle nesting habitat from disturbance. Two nests have been observed at Eniwetak during previous USAKA biennial surveys. The nests were left undisturbed and no attempt was made to estimate clutch size. However, we anticipate that about 100 eggs may have resided in each nest. Therefore, we estimate the productivity of this nesting area to be about 200 eggs per nesting season. Estimates of replacement vary considerably (e.g., 5,000 to 12,000 eggs = 1 adult) (P. Jokiel, pers. communication; and Limpus and Balazs 1991), but suggest that relative contributions of the conservation area, though similar to potential losses at Illeginni, would be modest, but would likely offset losses that may occur due to implementation of the proposed action.

Cumulative Effects of Non-Federal Activities

Cumulative effects include the effects of future RMI, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 3-4.5.3 of the UES.

Though Illeginni Islet is a USAKA-leased islet and closed to public access, it is possible that humans may gain access to the islet and harvest eggs or adult green sea turtles.

Conclusion

After reviewing the current status of the green turtle, the environmental baseline for the action area, the effects of the proposed shoreline stabilization, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of this species. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 3-4.8.1 of the UES prohibits the take of endangered and threatened species, respectively. Incidental take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

The measures described below are non-discretionary, and must be undertaken so that they become binding conditions. Because USAKA has command over all United States Government activities at USAKA-controlled islands, the Mid-Atoll Corridor, and USAKA-controlled activities within the RMI, these measures will be implemented by USAKA. However, the USAF must support implementation of these measures in coordination with USAKA. Furthermore, the USAF has a continuing duty to regulate the activity, in coordination with USAKA, covered by this incidental take statement. If the USAF (1) fails to support implementation of the terms and conditions or (2) fails to adhere to the terms and conditions of the incidental take statement, USAKA and the RMI may seek to enforce the terms. In order to monitor the impact of incidental take, the USAF must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement.

Amount or Extent of Incidental Take

The Service anticipates incidental take to occur in the form of harm or harassment to the breeding success or loss of up to three green turtle nests or injury or loss of up to 300 eggs or hatchlings per year as a result of project-related RV impacts at Illeginni Islet or during the process to transport eggs from Illeginni to the sea turtle conservation area at Eniwetak Islet.

Effect of the Take

The Service does not believe that this level of incidental take is likely to result in jeopardy to the species or destruction or adverse modification of critical habitat, as critical habitat is not designated in the project area. The level of take is not likely to result in jeopardy because the overall effect of the action will likely affect no more than three green turtle nests or

approximately 300 hatchlings per year at Illeginni Islet. Furthermore, these losses are expected to be offset by the implementation of conservation measures to protect green sea turtle nesting habitat at Eniwetak Islet. It is expected that about three sea turtle nests with an anticipated production of up to at least 300 green sea turtle hatchlings per year will be protected in perpetuity at Eniwetak Islet.

Reasonable and Prudent Measures

The reasonable and prudent measures given below, with their implementing terms and conditions, are designed to minimize the impacts of incidental take that might otherwise result from the proposed actions. If, during the course of the actions, the level of incidental take is

exceeded, the action agency is required to reinitiate consultation and review the reasonable and prudent measures provided in this biological opinion. In addition, the Army must cease the activities that caused the taking; must immediately provide an explanation of the causes of the taking; and must review with the Service the need for possible modification of the reasonable and prudent measures.

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts on green turtles.

- (1) Minimize the number of nests destroyed.
- (2) Monitor and report any incidental take that occurs.

Terms and Conditions

In order to be exempt from the prohibitions of section 3-4.8.1 of the UES, the USAF must comply with the following terms and conditions, which implement reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

In order to implement reasonable and prudent measure 1 above, the following term and condition applies:

1. The USAF will target the RVs away from the known sea turtle nesting areas within the Mid-Atoll Corridor Impact Area.

In order to implement reasonable and prudent measure 2 above, the following terms and conditions apply:

- 2.a. The USAF will work with the USAKA Environmental Management Office to inspect the RV impact zones to assess sea turtle mortality after each mission.
- 2.b. The USAF will submit an annual report by December 31 of each year to USAKA for the MMIIRV test flights, if any, that would have impacted in the vicinity of Illeginni Island. The USAKA Environmental Management Office will forward the report to the PIFWO Field Supervisor at the above address documenting take of green turtle and suggesting ways to further minimize incidental take at Illeginni Islet.

The PIFWO believes no more than 3 nests per year will be precluded from reaching complete incubation (*i.e.*, hatching). The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of this BO and review of the reasonable and prudent measures provided. The USAF must immediately provide an explanation of the causes of the taking and review with the USFWS the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations

Federal agencies may carry out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or develop information. When recommendations are provided, they relate only to the proposed action and do not necessarily represent complete fulfillment of an agency's responsibilities for the species.

- 1.a. The USAF may support eradication of all species of rats from Eniwetak and maintain this islet as a rodent free environment to encourage incubation and hatchling success.
- 1.b. The USAF may conduct a risk analysis of sea turtle exposure to DU and Beat Illeginni. Rats (*Rattus* sp) that occur within the vicinity of sea turtle nesting sites may be used as surrogates to supplement this analysis. The analysis should evaluate concentrations of DU or Be in the kidney, liver, bone and lung tissue.

This concludes consultation on the action described in the August 24, 2004 Draft EA for the Minuteman III Modification. Reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount of extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any questions concerning this BO, please contact Marine Ecologist Kevin Foster (phone: 808/792-9420; fax: 808/792-9581).

Sincerely,



Gina Shultz
for Acting Field Supervisor

Colonel Smith

12

cc: NMFS- PIRO
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USAF
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